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Vermont Agricultural Experiment Station

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THE TREES OF VERMONT

by G. P. BURNS and C. H. OTIS

1791

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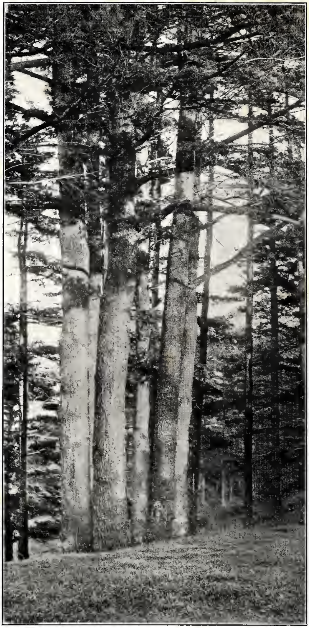

Photo by H. F. Perkins.

A NATURAL GROUP OF WHITE PINE ON THE GROUNDS OF THE UNIVERSITY OF VERMONT.

BULLETIN 194: THE TREES OF VERMONT

By G. P. Burns and C. H. Otis[1]

INTRODUCTION

The supply of bulletin 73, entitled "The Trees of Vermont," has been exhausted for several years. Repeated calls from all parts of the State and especially from the schools make it evident that its revision and reissue would be welcomed.

The present publication represents a revision of Bulletin 73 of the Vermont Agricultural Experiment Station, issued in 1899, and of Bulletin 16, Vol. XIV, N. S., of the University of Michigan, issued in 1913 under the authorship of the junior writer[2]. In the preparation of the present bulletin the authors have followed largely the general scheme and arrangement of the Michigan publication. Two chapters, "How to Study the Trees" and "Artificial Keys, How Made and Used," except for a few minor changes, are from the Michigan bulletin. The artificial keys for identification and the manual of trees have been adapted to the slightly different Vermont conditions. Most of the reproductions published in this bulletin have been made from new plates photographed from the drawings originally used to illustrate the Michigan bulletin. Credit has been indicated in each case. Finally, there have been added a series of bark photographs by the senior author, while the junior has contributed four original plates of drawings and accompanying descriptions and a section dealing with the identification and structure of Vermont woods. Upon the senior author has devolved the final bringing together of the component parts and the necessary editorial work involved.

This bulletin is intended primarily for the use of pupils in our public schools and of persons not especially trained in botany. For this reason the use of technical terms has been avoided whenever possible. In several cases such terms were necessary, but with the help of the glossary (page 233) their meaning can be easily understood.

The order of arrangement and nomenclature are essentially those of Gray's Manual. Following a tendency which is steadily gaining favor, all species names are printed with a small letter, regardless of their origin.

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[1] Professor Otis, formerly curator of the botanical garden and arboretum of the University of Michigan, spent several months during the past year at this institution, collaborating with the senior author in the preparation of this bulletin.

[2] The authors take this occasion to express their appreciation of the courtesy of the University of Michigan authorities in allowing them to make such liberal use of the material from the former bulletin in their present work.

Two sets of keys are given. One is based upon characters which are present during the summer; the other uses the winter characters as a basis for identification.

Photographs have not been used as illustrations because they are too indefinite and give all characters equal emphasis. This generally conceals the essential marks necessary for identification and affords little help to the student. Accurate line drawings are substituted for photographs, since they have proved to be much more serviceable in classwork.

It is believed that with the aid of the drawings and descriptions given in this bulletin any person will be able to identify any Vermont tree. If, however, difficulty is found in naming a given tree, specimens of flowers, fruit, leaves, wood, etc., mailed to the Extension Service, Burlington, Vermont, will be named without charge, if of such a character and received in such condition as will admit of identification.

HOW TO STUDY THE TREES

Trees are such familiar objects that the people who dwell in nearly every portion of this country see them daily. Trees give cooling shade in our parks and dooryards and along our highways; they lend their beauty to the landscape and relieve it of monotony; they yield many kinds of fruits, some of which furnish man and the animals of the forest with food; and they furnish vast quantities of lumber for a multitude of uses. It is important then that every person, whether in the schools or beyond school age, should become acquainted with our trees. Most people know a few of the more common trees but are ignorant of the great wealth of trees of various kinds about them. Some persons who may have wished to learn more have been hindered for lack of a teacher and others have been dismayed by the very multitude of manuals to which they have had access.

In beginning a study of trees the student should be careful to confine himself to well established facts. Once started he should proceed slowly, assimilating each new discovery before seeking another. He should begin with the trees nearest home and then becoming familiar with these in all their aspects, he should extend his trips afield. Not only should he be able to name the trees when they are fully clothed in summer garb, but he should know as readily the same trees when only the bare branches stand silhouetted against the sky if he desires to gain a thorough knowledge of his subject.

The characters which are used in studying the trees are habits, leaves, flowers, fruits, buds, bark, distribution and habitat. These will be discussed briefly in the next few pages, the same order that is used in the detailed descriptions of species being maintained in the present discussion. A few drawings also will be added to make certain points clear and to show comparative forms.

NAME.—Every tree has one or several common names and a scientific or Latin name. Some of these common names are merely local, while others have a more extended use. A few names apply to totally different species. Thus, cottonwood in Vermont is *Populus deltoides,* in Idaho and Colorado *Populus angustifolia,* in California *Populus fremontii* and in Kentucky *Tilia heterophylla.* While it should not be forgotten that in common speech it is proper as well as convenient to call trees by their common names, yet, in view of the many uncertainties pertaining to their use, a scientific name at times is absolutely essential to the clear understanding of what is meant. Latin is the language in universal use by all scientists. No longer used by any civilized nation, it has become a dead language and consequently never changes. Its vocabulary and its constructions a thousand years hence will probably be the same that they are today. Being in universal use among scientists of all nationalities no confusion arises from the use of a Latin word. The oak in Germany is known as *Eiche,* in France as *chêne* and in Spain as *roble,* but the Latin word *Quercus* is the same in all these countries.

A scientific name as applied to trees consists at least of two parts, as *Quercus alba.* The first is the genus name and always is written with a capital letter, the second is the species name and is written with a small letter, the two names constituting the briefest possible description of the particular tree. It is customary to add to these the name or an abbreviation of the name of the person who first gave the name to the tree, as *Quercus alba* L., the abbreviation standing for Linnaeus. Sometimes a third name is used, as *Acer saccharum nigrum,* referring in this instance to a variety of the ordinary Sugar Maple. In some cases trees have more than one Latin name. When this is true the synonym or synonyms are placed in brackets after the accepted name.

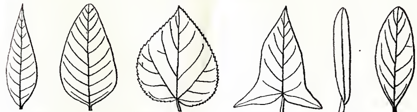
Genera which bear a relationship to each other are placed in the same family, the family name always having the characteristic ending—*aceae.* Related families again are grouped into orders, with the characteristic ending—*ales.* Orders in like manner are arranged into larger groups, called classes, and the latter into still larger groups, divisions, etc., each with its characteristic ending. Thus, *Acer saccharum nigrum* (Michx. f.) Britt. is classified as follows:

- Division—Spermatophyta
  - Subdivision—Angiospermae
    - Class—Dicotyledoneae
      - Order—Sapindales
        - Family—Aceraceae
          - Genus—Acer
            - Species—saccharum
              - Variety—nigrum.

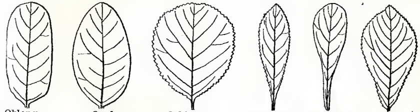
HABIT.—Habit, or the general appearance of a plant, is an important character of identification, especially as we become more and more familiar with the trees. Two main types are recognized, based on the manner of the branching of the trunk, the upright and the spreading. In the one the trunk extends straight upwards without dividing, as is typical in most of the conifers; in the other the trunk divides to form several large branches and the broad, spreading crown of most of our broad-leaf trees. In either case the crown may be regular in outline or very irregular, straggling or straight-limbed. Moreover, the tree growing in the open, where there is no crowding and plenty of light, may differ greatly from the tree in the forest, where the struggle for existence becomes very keen. A short, thick trunk and a low, spreading, many-branched crown characterize the tree in the open, whereas the forest tree has a long, slender, clean trunk and a narrow crown of few branches. In the descriptions of trees in this bulletin, unless otherwise stated, the habit in the open is the one given. Again, the tree may have been injured by storm or insect at some period of its growth and its natural symmetry destroyed. Moreover, the age of a tree has a great influence on its outline, young trees generally being narrow and more or less conical, broadening out as they become older. We may say, then, that each tree has an individuality of its own, little eccentricities similar to those that make people different from one another. And just as we have little difficulty in recognizing our friends at a distance by some peculiarity of walk or action, so we are able to recognize many trees at a distance by some peculiarity of form or habit.

LEAVES.—With the advent of spring the buds of our broad-leaf trees swell and burst and the leaves come forth and clothe the trees with mantles of green, hiding the branches which have been bare through the cold winter months. The evergreens, too, take on fresh color and commence a new period of growth. The beginner in botanical study finds the leaves the most interesting portion of a tree and one which affords him a ready means of identification. It must be remembered, however, that leaves vary greatly in size, shape and general appearance. For example, the leaves on a flourishing sprout are usually relatively large, whereas they may be much smaller on a stunted tree of the same species growing nearby and subjected to adverse circumstances.

I. LEAF OUTLINES



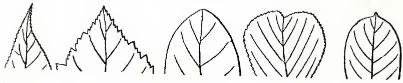
Lanceolate. Ovate. Heart-shaped. Halberd-shaped. Linear. Elliptical.



Oblong. Oval. Orbicular. Oblanceolate. Spatulate. Obovate.

The leaves of a big white oak standing in the yard may be hardly lobed on the lowermost branches, while higher up they are deeply cut.

II. LEAF TIPS

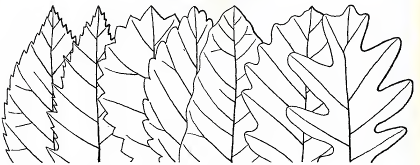


Acuminate. Acute. Obtuse. Emarginate. Mucronate.

However, in spite of the many modifications they undergo, the leaves of any one species have certain rather constant characteristics which are found in all forms, and the student who has once learned what these are will have little difficulty in selecting and recognizing typical specimens.

Leaves are either persistent, as in most of our conifers, which remain green all winter, or they assume various colors with the coming of the frost, and drop to the ground early in autumn although often they hang dead and lifeless far into the winter. The characteristics of leaves which we are accustomed to consider in determining their relationships are their position or arrangement on the branch, whether simple or compound, size, shape, texture, color, the amount and character of pubescence, the character of the margin, venation, etc. The following diagrams will serve to illustrate some of the ordinary forms and shapes of leaves, their margins, etc.

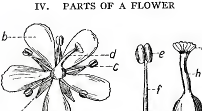
III. LEAF MARGINS



Serrate. Doubly Serrate. Dentate. Crenate. Undulate. Sinuate. Lobed.

FLOWERS.—Every tree when old enough bears flowers in its proper season. Some of these, as the hawthorns, locusts and horse-chestnuts, are very showy; others, like the oaks and hickories, are comparatively inconspicuous. Some are brilliantly colored, while others are of the same color as the leaves. Nevertheless, the flowers are very accurate means of classification, and the only drawback to their use for this purpose is the fact that they last for such a little while each year.

IV. PARTS OF A FLOWER

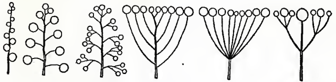


Perfect Flower. Stamen. Pistil.

a. Sepal (Calyx).
b. Petal (Corolla).
c. Stamen.
d. Pistil.
e. Anther.
f. Filament.
g. Stigma.
h. Style.
i. Ovary.

Just as there are male and female in the animal world, so the male and the female are found in the plant world. A few of our trees, as the locust, basswood and cherry, have perfect flowers, bearing both stamens and pistil. The great majority, however, have unisexual flowers, bearing either stamens or pistils, but not both. When both male and female flowers are found on the same tree, the flowers are said to be monoecious, and when male flowers occur on one tree and the female on a different tree, the flowers are said to be dioecious. The cottonwood of New England is dioecious and each little seed is surrounded by a tuft of long, white hairs which enables the wind to carry it considerable distances from the parent tree, to the disgust of people living within its range. The planting of the cottonwood is forbidden within the bounds of several cities on account of this objection. Since it is desirable in some places to plant this rapidly growing tree, as in cities burning large amounts of soft coal, it is a distinct advantage to know that the male trees may be planted safely, since they bear no seed and shed no "cotton."

V. TYPES OF INFLORESCENCES

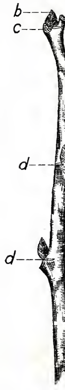


Spike. Raceme. Panicle. Corymb. Umbel. Cyme.

Before trees can produce fruit their flowers must be fertilized, i. e., pollen from the anther of a stamen must come in contact with the stigma of a pistil. Some flowers are self-fertilized and others are cross-fertilized. For a long time it was not understood how fertilization was accomplished, but now we know that many insects, like the nectar-loving bees and butterflies, and in other instances the wind, transport the pollen from one flower to another, often miles being traversed before the right kind of flower or a flower in the right stage of development is found. And many are the modifications of flowers to insure this transference of pollen.

FRUIT.—So numerous and so varied are the forms of tree fruits that it would be only confusing to state their characters. Some fruits, such as the achenes of the poplars and willows, are so small and light that they are carried long distances by the wind; others, like the hickory nuts and walnuts, are too heavy to be wind-blown. Many fruits are of considerable economic and commercial importance and are gathered and marketed on a large scale. Among these are the hickory nuts, walnuts, chestnuts, etc. Some, not esteemed by man, form an important article of diet for the birds and small animals of the forest. Unfortunately there are a number of limitations to the usefulness of fruit for identification purposes. Some trees require years to mature their fruit. Many trees, while producing an abundance of fruit at certain intervals, bear none at all or only very small and uncertain quantities between the years of abundance. Again, in the case of dioecious trees, only the female or pistillate bear fruit. Notwithstanding these limitations tree fruits are a very valuable aid to the student, and he should always search closely for evidences of their presence and character.

VI. WINTER TWIG OF RED MULBERRY

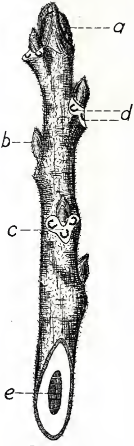


a. Tip-scar.
b. Lateral bud.
c. Leaf-scar.
d. Stipule-scars.

WINTER-BUDS.—Buds, with their accompanying leaf- and stipule-scars, form the basis of tree identification in winter. The size, color, position with reference to the twig, number and arrangement and character of bud-scales, etc., all are characters of the greatest value in winter determinations. Buds either are terminal or lateral, depending on their position on the twig. A lateral bud is one situated on the side of a twig in the axil of a leaf-scar. A terminal bud is one situated at the end of a twig, where it is ready to continue the growth of the twig the following spring. To the presence or absence of the terminal bud is accorded much importance in the keys on pages 162 and 163, which enable one more surely to identify a tree. Inasmuch as the determination of this point gives the beginner some trouble at first, it is hoped that the accompanying diagrams and explanatory remarks will serve to make the distinction clear.

In the elms, willows, basswood and many other species the terminal bud and a small portion of the tip of the twig dies and drops off in late autumn, leaving a small scar at the end of the twig (a, fig. VI). The presence of this tip-scar indicates that the terminal bud is absent. Often a lateral bud will be found very close to the tip-scar (b, fig. VI), which, bending into line with the twig, makes it appear to be a terminal rather than a lateral bud. However, the presence of a leaf-scar immediately below it shows it to be a lateral bud (c, fig. VI). The unaided eye can discern the tip-scars on some of the larger twigs, but a hand lens will be found necessary when the smaller twigs are under observation.

VII. WINTER TWIG OF BLACK WALNUT



a. Lateral bud.
b. Lateral bud.
c. Leaf-scar.
d. Bundle-scars.
e. Pith.

The arrangement, size and shape of the leaf-scars (c, fig. VII) are important factors in identification by winter characters. Within the leaf-scars are one or more dots (d, fig. VII), sometimes quite inconspicuous, often very prominent. These are the scars left by the fibro-vascular bundles which run through the petiole into the blade of the leaf, and are designated as bundle-scars. There may be many as in the oaks, three as in the poplars and cherries, or only one as in tamarack and the spruces; and they may be arranged in a U- or V-shaped line, or they may be without definite order. Often stipule-scars (d, fig. VI) occur on either side of the leaf-scar and are caused by the fall of a pair of small leaflets called stipules, located at the base of the leaves. Their form varies according to the form of the stipules which made them

BARK.—The woodsman uses the bark more than any other feature in identifying trees, and often he is able in this manner to distinguish trees with much accuracy at great distances. However, the appearance of bark differs so greatly with the age of the tree and with its environment that it is difficult to describe it accurately. Some characters are distinctive, however, and serve as a ready means of identification; as for example the peeling of the sycamore and paper birch, the "shelling" of the shellbark hickory and the mucilaginous inner bark of the slippery elm.

WOOD.—Under this heading are exhibited some of the general characteristics of wood. While it is not expected that this information will be of any particular value to the student of tree botany in identifying living trees, it happens often that such a one finds himself in the midst of felling operations or in the lumberyards; and under such circumstances a knowledge of the wood characters may be of considerable value. Few, if any, manuals or bulletins have been published dealing in a simple but comprehensive manner with the structure of wood. Especially is this true of the photographs or drawings accompanying such works. It hardly comes within the scope of this bulletin to discuss in detail all the woods of all the tree species growing in Vermont, although such a study doubtless would be worth while. Yet there does seem to be an urgent demand for such a publication dealing with our more common trees; and hence a detailed study has been made of such of our woods as are of importance from a lumbering standpoint. Illustrations, showing cross-, radial- and tangential-sections, accompanied by descriptions and keys, have been brought together in a chapter at the end of the manual proper, to which are referred persons desirous of a more thorough acquaintance with our commercial woods.

DISTRIBUTION AND HABITAT.—To a lesser extent do distribution and habitat of a species aid in the identification of a tree. It is a distinct advantage to know that the wild plum is native in western Vermont only and that the black gum is limited to the southernmost portions of the state. So, too, knowing the water-loving habit of the swamp spruce, we would not expect to find it flourishing on a rocky mountain-top.

The characteristics, then, which are used to identify the trees about us are many. Not all will be available at any one time, and not all have been mentioned in the foregoing pages nor in the manual. It is our opinion, however, that the student will not be handicapped greatly by this lack of detail, but rather that he will take great interest and genuine pleasure in discovering these things for himself.

ARTIFICIAL KEYS, HOW MADE AND USED

An artificial key is a scheme for identifying any unknown object under consideration easily and quickly. This bulletin being devoted to the trees of Vermont, its keys are intended to make it possible for any person, even if his botanical training be meager, to determine what native trees grow about his home or farm or in any Vermont city park or woodlot. With certain modifications and within limitations they may prove useful in other localities as well.

Since many people are unfamiliar with the construction and use of keys for purposes of identification, it is the purpose of the following paragraphs briefly to outline the principles upon which they are built and the manner in which they are used.

The keys are based on the most striking similarities and differences manifested by the various parts of trees—twigs, buds, leaves, etc.—that is to say, those characters which stand out in bold relief, which catch the eye at first sight. Two alternatives are presented, either a character *is* or *is not* presented; these are the only choices possible. Indeed, further divisions are unnecessary and lead only to confusion and possible oversight. The two diametrically opposed characters are said to be coordinate in rank. In the keys they are preceded by the same letter or letters (*a* and *aa* or *b* and *bb,* etc.) and are set at the same distance from the left margin of the page. Often *a* and *aa,* or *b* and *bb* are divisible further into other groups; in every case the characters are opposed (a positive and a negative) and are given coordinate rank. It is desirable for mechanical reasons to divide the main divisions of the key more or less evenly, but this is not always feasible, nor should it be adhered to strictly.

The nature and use of a key may be made the more clear by a homely but concrete example. Let us suppose that it is desired to construct a key in order to distinguish from one another five houses in a city block. Three of these houses are built of wood, two of brick, and of the three wooden houses two are painted white and one brown. We may classify them as follows:

a. Houses wood.
  b. Body paint brown .... *Smith's house*
  bb. Body paint white.
    c. Trimmings green color .... *Jones' house*
    cc. Trimmings slate color .... *Brown's house*
aa. Houses brick.
  b. Roof gray slate .... *Johnson's house*
  bb. Roof red tile .... *Public library*

It is desirable in many instances to add other characters to lessen the likelihood of confusion, in cases where the characters chosen are not distinct, and in order to show the user that he is on the right track. Thus, in the example just given, green color and slate color might be confused owing to certain defects of the eye, to a coating of dust or deficiencies of the light. Hence we would be justified in adding to the above statements additional distinguishing characteristics. Thus:

bb.
  c. Trimmings green color; gable roof.............*Jones' house*
  cc. Trimmings slate color; mansard roof.........*Brown's house*

The keys in this bulletin are constructed on these principles. They are not always as simple as the illustration just used, but if the reader has mastered the house illustration he will have little or no trouble with the larger keys. In order that the usage of the keys may be made the more clear, the following example, couched in language using the personal pronoun, is set forth at some length. The reader is advised to trace it from beginning to end as a ready means of familiarizing himself with the use of and possibilities of the key system.

Suppose that during a summer stroll you come across a large tree with rough, flaky bark and thin, lobed leaves which you do not know. Turning to the *Summer Key to the Genera* on pages 16 to 19, you find first *a Leaves simple,* and contrasted with this *aa Leaves compound.* Obviously the leaf is simple and the genus sought lies in that portion of the key preceding *aa,* i. e., under *a.* The subdivisions, *b,* and *bb,* under *a* afford you a choice between *Leaves needle-shaped, awl-shaped, strap-shaped or scale-like* and *Leaves broad and flat.* The leaf being broad and flat you pass onwards in the key to *c* and *cc* under *bb.* Here you have a choice between *Leaves alternate or clustered* and *Leaves opposite.* Inspection shows the arrangement to be alternate, and you know that the genus sought lies in that portion of the key which lies between *c* and *cc.* Passing to *d* and *dd* under *c* you are offered the choice between *Margin of leaves entire or only slightly undulate* and *Margin of leaves serrate, toothed or lobed* and your observation clearly indicates that the leaf is neither entire nor undulate, hence are in *dd* class. Under *dd* you may choose between *e, Margin of leaves serrate to toothed* and *ee, Margin of leaves distinctly lobed.* The leaf being deeply lobed, you know that the genus sought is one of five lying between *ee* and *cc,* all of which have lobed leaves. To make the determination, you must look for the fruit, since *f* and *ff* under *ee* give a choice between *Fruit an acorn* and *Fruit not an acorn.* You poke about in the grass beneath the tree with your foot, finding an acorn, water-soaked and worm-eaten, and then another. But these may have been carried hither by an industrious squirrel or washed here by the rain or blown by the wind and deposited for the entrapment of the unwary. Hence you look up into the tree for affirmation and observing more closely than heretofore you note that the young, green acorns are quite apparent. The genus, then, is *Quercus.*

Before going further in your pursuit it will be well for you to go back over the key to make careful note of the particular characters which were used to separate this genus from the other genera and to try to fix these in mind. This being done, you should turn to the page indicated, where you will find a *Summer Key to the Species of Quercus.* You may then run through this key in the same manner that you did the genus key. If you have been careful in your search you will stop finally at *Quercus alba.* At this point you will do well once more to pause and go back over this key and try to fix in mind the characters which were used to separate the various species, especially the difference between your tree and *Quercus macrocarpa,* which it resembles so closely. This done, you will turn to the page indicated and compare the characters of your tree with the drawings and descriptions. If you are satisfied with your diagnosis, well and good. If you find that you are wrong, go over the keys again and find wherein you were led astray.

Before you leave the tree take a sample of leaf properly labeled which you can press between the pages of an old magazine and save for future reference. Do this with other trees which you may find and when you get home lay them out side by side so that the labels will not show and compare them. A few trials of this kind will serve to form a mental picture of each leaf which you will remember.

A very helpful practice for the beginner is that of making keys based upon various characters. Practice keys of this kind will bring out the differences and likenesses of trees as will no other means, and characters which hitherto have escaped the eye will be brought forward prominently. Nor should the student take his characters from books, but rather should go to the woods and get his knowledge at first hand.

It is hardly necessary to state that while the key is a valuable crutch while learning to walk, once the leg is strong enough to bear the weight it should be discarded, lest it becomes a burden. A key's main function is the guidance of the student through the preliminary steps leading to a more intimate knowledge of the trees.

SUMMER KEY TO THE GENERA

a. Leaves simple.
  b. Leaves needle-shaped, awl-shaped, strap-shaped or scale-like.
    c. Leaves in clusters of 2-many.
      d. Leaves in clusters of 2-5 sheathed, persistent for several years .... **Pinus,** p. 25.
      dd. Leaves in fascicles of 8-many, on short, lateral branchlets, deciduous in autumn.................. **Larix,** p. 35.
    cc. Leaves solitary, not clustered.
      d. Leaves opposite.
        e. Twigs flattened; leaves all of one kind, scale-like, decurrent on the stem; fruit a small, pale brown cone, **Thuja,** p. 51.
        ee. Twigs essentially terete; leaves of two kinds, either scale-like, or else awl-shaped, often both kinds on the same branch, not decurrent on the stem; fruit berry-like, bluish .... **Juniperus,** p. 53.
      dd. Leaves alternate or spirally-whorled.
        e. Leaves flattened, soft to the touch.
          f. Leaves ½-1¼ inches long, sessile, aromatic; cones 2-4 inches long; bark of trunk with raised blisters containing resin .... **Abies,** p. 47.
          ff. Leaves seldom over ½ inch long, short-petioled, not aromatic; cones about ¾ inch long; bark of trunk without raised blisters .... **Tsuga,** p. 49.
        ee. Leaves 4-sided, harsh to the touch........ **Picea,** p. 37.
  bb. Leaves broad and flat.
    c. Leaves alternate or clustered, never opposite.
      d. Margin of leaves entire or only slightly undulate.
        e. Leaves 2-5 inches long; fruit a drupe or berry, **Nyssa,** p. 183.
        ee. Leaves 5-9 inches long; fruit an acorn.. **Quercus,** p. 112.
      dd. Margin of leaves serrate, toothed or lobed.
        e. Margin of leaves serrate to toothed.
          f. Branches armed with stiff, sharp thorns, **Crataegus,** p. 147.

- *ff*. Branches not armed.
  - *g*. Base of leaves decidedly oblique.
    - *h*. Leaf-blades about as long as they are broad, heart-shaped; fruit globose, woody, ripe in autumn, **Tilia,** p. 181.
    - *hh*. Leaf-blades 1½-2 times as long as they are broad, oval to ovate; fruit a membranaceous samara, ripe in spring .... **Ulmus,** p. 129.
  - *gg*. Base of leaves essentially symmetrical.
    - *h*. Teeth coarse, 2-5 per inch of margin.
      - *i*. Leaves very glabrous both sides; fruit a prickly bur.
        - *j*. Leaves 3-5 inches long, very lustrous beneath; bark close, smooth, steel-gray.. **Fagus,** p. 107.
        - *jj*. Leaves 6-8 inches long, not lustrous beneath; bark fissured, brownish.... **Castanea,** p. 108.
      - *ii*. Leaves pubescent or white-tomentose, at least beneath; fruit not a prickly bur.
        - *j*. Leaves 2-4 inches long, broadly ovate to suborbicular; fruit a very small capsule, falling in spring .... **Populus,** p. 60.
        - *jj*. Leaves 4-7 inches long, oblong-lanceolate to obovate; fruit an acorn, falling in autumn, **Quercus,** p. 112.
    - *hh*. Teeth fine, 6-many per inch of margin.
      - *i*. Leaf-petioles laterally compressed; leaves tremulous .... **Populus,** p. 60.
      - *ii*. Leaf-petioles terete; leaves not tremulous.
        - *j*. Leaf-blades at least 3 times as long as they are broad.
          - *k*. Twigs brittle; fruit a very small capsule, falling in spring .... **Salix,** p. 55.
          - *kk*. Twigs tough; fruit a fleshy drupe, falling in late summer or autumn.... **Prunus,** p. 149.
        - *jj*. Leaf-blades not more than twice as long as they are broad.
          - *k*. Leaf-blades about twice as long as they are broad.
            - *l*. Margin of leaves singly serrate; fruit fleshy.

m. Lenticels conspicuous; pith whitish or brownish; bark easily peeled off in papery layers; buds ovoid, **Prunus,** p. 149.

mm. Lenticels inconspicuous; pith greenish; bark not separable into papery layers; buds narrow-conical, **Amelanchier,** p. 145.

ll. Margin of leaves doubly serrate; fruit not fleshy.

m. Trunk fluted; fruit inclosed within a halberd-shaped involucre, **Carpinus,** p. 95.

mm. Trunk not fluted; fruit not inclosed within a halberd-shaped involucre.

n. Bark of trunk gray-brown, broken into narrow, flattish pieces loose at the ends; fruit in hop-like strobiles, **Ostrya,** p. 93.

nn. Bark of trunk white, yellow or dark brown, platy or cleaving off in papery layers; fruit not in hop-like strobiles ....**Betula,** p. 97.

kk. Leaf-blades almost as broad as they are long.

l. Lower side of leaves more or less downy; sap milky; leaves not crowded on short, spur-like branchlets; fruit berry-like, black ....**Morus,** p. 137.

ll. Lower side of leaves glabrous; sap not milky; leaves crowded on short, spur-like branchlets; fruit a large, green pome, **Pyrus,** p. 143.

ee. Margin of leaves distinctly lobed.

f. Fruit an acorn....................**Quercus,** p. 112.

ff. Fruit not an acorn.

g. Leaf-lobes entire; leaves lustrous above, their petioles 5-6 inches long......**Liriodendron,** p. 139.

- *gg*. Leaf-lobes sinuate-toothed to serrate; leaves not lustrous above, their petioles 1-2 inches long.
  - *h*. Leaf-lobes coarsely sinuate-toothed; winter-buds forming in summer within the petiole of the leaf, **Platanus,** p. 141.
  - *hh*. Leaf-lobes serrate; winter-buds not forming in summer within the petiole of the leaf.
    - *i*. Branches armed with stiff, sharp thorns; sap not milky ....**Crataegus,** p. 147.
    - *ii*. Branches unarmed; sap milky,...**Morus,** p. 137.
- *cc*. Leaves opposite.............................**Acer,** p. 162.

- *aa*. Leaves compound.
  - *b*. Leaves alternate.
    - *c*. Branchlets armed with short, sharp prickles.. **Robinia,** p. 159.
    - *cc*. Branchlets unarmed.
      - *d*. Upper leaflets less than 1 inch broad; fruit berry-like, ¼ inch in diameter ....**Pyrus,** p. 143.
      - *dd*. Upper leaflets 1-5 inches broad; fruit a nut an inch or more in diameter.
        - *e*. Leaflets 5-11; pith homogeneous.......... **Carya,** p. 83.
        - *ee*. Leaflets 11-23; pith chambered..........**Juglans,** p. 77.
  - *bb*. Leaves opposite.
    - *c*. Leaves pinnately compound; fruit a samara.
      - *d*. Leaflets 3-5; samaras paired...............**Acer,** p. 162.
      - *dd*. Leaflets 7-11, exceptionally 5; samaras not paired, **Fraxinus,** p. 185.
    - *c*. Leaves digitately compound; fruit a prickly bur, **Aesculus,** p. 179.

WINTER KEY TO THE GENERA

a. Leaves persistent and green through the winter, needle-shaped, awl-shaped or scale-like.

- *b*. Leaves in clusters of 2-5, sheathed.............. **Pinus,** p. 25.
- *bb*. Leaves solitary, not clustered.
  - *c*. Leaves opposite.
    - *d*. Twigs flattened; leaves all of one kind, scale-like, decurrent on the stem; fruit a small pale brown cone.. **Thuja,** p. 51.
    - *dd*. Twigs essentially terete; leaves of two kinds, either scale-like, or else awl-shaped, often both kinds on the same branch, not decurrent on the stem; fruit berry-like, bluish, **Juniperus,** p. 53.
  - *cc*. Leaves alternate or spirally-whorled.
    - *d*. Leaves flattened, soft to the touch.
      - *e*. Leaves ½-1¼ inches long, sessile, aromatic; cones 2-4 inches long; bark of trunk with raised blisters containing resin .... **Abies,** p. 47.
      - *ee*. Leaves seldom over ½ inch long, short-petioled, not aromatic; cones about ¾ inch long; bark of trunk without raised blisters .... **Tsuga,** p. 49.
    - *dd*. Leaves 4-sided, harsh to the touch........... **Picea,** p. 37.

aa. Leaves not persistent and green throughout the winter, but deciduous in early autumn.

- *b*. Twigs, branches or trunks armed with stiff, sharp spines or thorns.
  - *c*. Thorns or spines not exceeding ½ inch in length on the branches, in pairs at each node; buds rusty-hairy, 3-4 superposed; fruit a flat pod .... **Robinia,** p. 159.
  - *cc*. Thorns or spines much exceeding ½ inch in length on the branches, not in pairs at each node; buds not rusty-hairy, not superposed; fruit a pome .... **Crataegus,** p. 147.
- *bb*. Twigs, branches or trunks unarmed.
  - *c*. Leaf-scars mainly crowded on short, stout, lateral shoots; bundle-scar 1; fruit a cone .... **Larix,** p. 35.
  - *cc*. Leaf-scars distributed along the lateral branches; bundle-scars 3-many; fruit not a cone.
    - *d*. Leaf-scars 2 at a node, i. e., opposite.
      - *e*. Terminal buds ½-1½ inches long, resin-coated; twigs very stout .... **Aesculus,** p. 179.

ee. Terminal buds rarely exceeding ½ inch in length, not resin-coated; twigs not conspicuously stout.

f. Bundle-scars usually 3, distinct, separated . **Acer,** p. 163.

ff. Bundle-scars many, minute, more or less confluent in a U-shaped line .... **Fraxinus,** p. 185.

dd. Leaf-scars 1 at a node, i. e., alternate.

e. Bundle-scars 3 or in 3 compound, but distinct groups.

f. Terminal bud present.

g. Stipule-scars present.

h. First scale of lateral bud directly in front, i. e., exactly above the center of the leaf-scar; twigs brittle; pith somewhat star-shaped in cross-section .... **Populus,** p. 61.

hh. First scale of lateral bud not directly in front, i. e., to one side of the center of the leaf-scar; twigs not brittle; pith circular in cross-section, **Prunus,** p. 149.

gg. Stipule-scars absent.

h. Buds bright to dark red, the terminal ⅛-¼ inch long .... **Nyssa,** p. 183.

hh. Buds brownish to gray, the terminal exceeding ¼ inch in length.

i. Buds narrow-conical, sharp-pointed; leaf-scars small, narrowly crescent-shaped; twigs about 1/16 inch thick; pith homogeneous; fruit berry-like, not present.............. **Amelanchier,** p. 145.

ii. Buds broadly conical to ovoid, blunt-pointed; leaf-scars conspicuous, broadly heart-shaped; twigs about ¼ inch thick; pith chambered; fruit a nut, often present........... **Juglans,** p. 77.

ff. Terminal bud absent (sometimes present on short shoots of *Betula*).

g. Stipule-scars present.

h. Bud-scale only 1 visible; twigs brittle, **Salix,** p. 55.

hh. Bud-scales 2 or more; twigs not brittle.

i. Bark smooth, close, warty or peeling off in papery layers, but not flaky nor rough-ridged.

j. Trunk fluted; catkins not present in winter; lenticels not elongated horizontally; low tree or bushy shrub .... **Carpinus,** p. 95.

jj. Trunk not fluted; catkins usually present in winter; lenticels elongated horizontally; large trees .... **Betula,** p. 97.

ii. Bark flaky or rough-ridged, not warty nor peeling off in papery layers.

j. Bundle-scars depressed, conspicuous; bark thick, more or less deeply furrowed, **Ulmus,** p. 129.

jj. Bundle-scars not depressed, inconspicuous; bark thin, broken into narrow, flattish strips, loose at the ends............ **Ostrya,** p. 93.

gg. Stipule-scars absent................ **Prunus,** p. 149.

ee. Bundle-scars 4-many.

f. Bundle-scars in a single U-shaped line.

g. Terminal bud present; fruit berry-like; a shrub or small tree .... **Pyrus,** p. 143.

gg. Terminal bud absent; fruit not berry-like; large trees.

h. Stipule-scars encircling the twig; leaf-scars nearly surrounding the bud; bark peeling off in thin plates, exposing the lighter colored inner bark, **Platanus,** p. 141.

hh. Stipule-scars not encircling the twig; leaf-scars not nearly surrounding the bud; bark thick, rough-ridged, not exposing the inner bark, **Ulmus,** p. 129.

ff. Bundle-scars variously grouped or scattered, but not in a single line.

g. Terminal bud present.

h. Stipule-scars present.

i. Stipule-scars encircling the twig; visible bud-scales 2, united....... **Liriodendron,** p. 139.

ii. Stipule-scars not encircling the twig; visible bud-scales more than 2, not united.

j. Buds 4 times as long as broad, not clustered at the tips of vigorous shoots; fruit a prickly bur .... **Fagus,** p. 107.

jj. Buds not 4 times as long as broad, usually clustered at the tips of vigorous shoots; fruit an acorn .... **Quercus,** p. 113.

hh. Stipule-scars absent .... **Carya,** p. 83.

- *gg*. Terminal bud absent (occasionally present in *Castanea*).
  - *h*. Bud at end of twig very obliquely unsymmetrical, mucilaginous when chewed........**Tilia,** p. 181.
  - *hh*. Bud at end of twig symmetrical, not mucilaginous when chewed.
    - *i*. Bud-scales 2-3 visible; pith star-shaped in cross-section; sap not milky; fruit a prickly bur, present; large tree ....**Castanea,** p. 108.
    - *ii*. Bud-scales 4-8 visible; pith not star-shaped in cross-section; sap milky; fruit berry-like, not present; small tree............**Morus,** p. 137.

PINACEAE—PINE FAMILY

THE PINES

The pines are the largest and most useful group of trees included in the great cone-bearing family. There are nine different species in the eastern United States, four of which are found in Vermont.

The pines, like the other members of this family, produce their seeds in cones. They are peculiar, however, in that their cones require two years for maturing. The flowers also take the form of cones, the pollen-bearing and the ovule-bearing clusters being separated, though both may be found on the same tree. The yellow pollen matures in May or June, when it is scattered in great abundance, to be borne to its destination by the wind. Most of the seed-bearing cones develop on the upper branches, and the nut-like seeds escape from them during the second autumn. The empty cones with opened scales thereafter may cling to the tree for some time or they may fall soon.

The leaves of all the evergreens cling to the branches several years. The leaves of the white pine, for example, drop when they are three or four years old. The arrangement of the leaves, or needles, in clusters of from two to five, with the base of each cluster encased in a delicate sheath, offers a simple means of distinguishing the species.

Introduced species.—Two European pines, the Austrian and the Scotch, are often planted in Vermont as forest trees as well as for ornamental purposes. The Scotch pine has leaves two in a cluster, 2-4 inches long, flat and of a bluish-white hue. The Austrian pine has dark green, slender, rigid leaves, two in a cluster, 4-6 inches long.

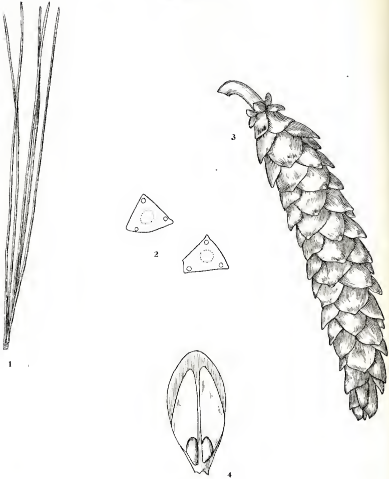
SUMMER AND WINTER KEY TO THE SPECIES OF PINUS

a. Leaves 5 in a cluster; cones 4-10 inches long .... **P. strobus,** p. 27.

aa. Leaves not 5 in a cluster; cones less than 4 inches long.

- *b.* Leaves 2 in a cluster; cone-scales unarmed, or at most provided with minute prickles.
  - *c.* Leaves less than 4 inches long (about 1 inch), strongly divergent; cones pointing forward towards the tip of the branch, persistent 10-15 years, opening very unevenly, **P. banksiana,** p. 31.
  - *cc.* Leaves 4-6 inches long, not strongly divergent; cones not pointing forward towards the tip of the branch, not persistent 10-15 years, but opening in the autumn of the second season and falling the next summer .... **P. resinosa,** p. 33.
- *bb.* Leaves 3 in a cluster; cone-scales armed with conspicuous prickles .... **P. rigida,** p. 29.

White Pine



(Mich. Trees).

1. Cluster of leaves, x 1.
2. Cross-sections of leaves, enlarged.
3. Partly opened cone, x ¾.
4. Cone-scale with seeds, x 1.

PINACEAE

White Pine

Pinus strobus L.

HABIT.—A large tree 60-80 feet high, with a trunk diameter of 2-4 feet; forming a wide, pyramidal crown. Formerly trees 100-150 feet in height and 5-7 feet in trunk diameter were not exceptional.

LEAVES.—In clusters of five; 3-5 inches long; slender, straight, needle-shaped, 3-sided, mucronate; pale blue-green. Persistent about 2 years.

FLOWERS.—June; monoecious; the staminate oval, light brown, about ⅓ inch long, surrounded by 6-8 involucral bracts; the pistillate cylindrical, about ¼ inch long, pinkish purple, long-stalked.

FRUIT.—Autumn of second season, falling during the winter and succeeding spring; pendent, short-stalked, narrow-cylindrical, often curved, greenish cones, 4-10 inches long; scales rather loose, slightly thickened at the apex; seeds red-brown, ¼ inch long, with wings 1 inch long.

WINTER-BUDS.—Oblong-ovoid, sharp-pointed, yellow-brown, ¼-½ inch long.

BARK.—Twigs at first rusty-tomentose, later smooth and light brown, finally thin, smooth, greenish; thick, dark gray on the trunk, shallowly fissured into broad, scaly ridges. Plate I.

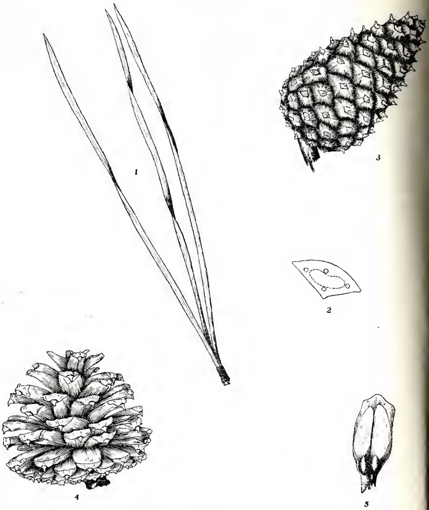
WOOD.—Light, soft, weak, compact, straight-grained, easily worked, light brown, with thin, whitish sapwood. Page 215.

DISTRIBUTION.—Common throughout the state up to 1,000 feet altitude, but most abundant in the Champlain and Connecticut valleys.

HABITAT.—Prefers a light, fertile loam; sandy soils of granite origin.

NOTES.—The white pine, growing as it does sometimes to immense height, was one of the loftiest trees of the primeval New England forest. Lumbermen have removed most of the patriarchs and only the younger trees commonly remain. Its slender lustrous leaves are borne in close clusters and give it a beauty and delicacy of foliage possessed by no other pine. It is one of the most valuable and most rapidly growing of Vermont's timber trees and is being planted every year by the thousands in our state forests and by private owners.

Pitch Pine



1. Cluster of leaves, x 1.
2. Cross-section of leaf, enlarged.
3. Unopened cone, x 1.
4. Opened cone, x 1.
5. Cone-scale with seeds, x 1.

PINACEAE

Pitch Pine

Pinus rigida Mill.

Habit.—A small tree 40-60 feet high, with a short, crooked trunk 1-2 feet in diameter; coarse, gnarled branches form an irregular, open, pyramidal or rounded crown; a decidedly scraggly tree.

Leaves.—In clusters of three; 2-5 inches long; stout, stiff, tapering to a thick tip; more or less twisted, divergent from a short sheath; bright yellow-green. Persistent 2-3 years.

Flowers.—May-June; monoecious; the staminate in short, crowded, cylindrical spikes about ¾ inch long, yellowish; the pistillate lateral, subglobose, short-stalked, more or less clustered, reddish-green, about ⅛ inch long.

Fruit.—Autumn of second season, opening soon after, but persistent on the tree for 10-12 years; lateral, at about a right angle to the branch, either solitary or in whorls of several; ovoid to nearly globose, nearly sessile cones 1-3 inches long; scales thickened at the apex and armed with a stiff, recurved prickle; seeds triangular, dark brown, ¼ inch long, with wings about ½ inch long.

Winter-buds.—Cylindrical to ovoid, sharp-pointed, dark red-brown, about ½ inch long.

Bark.—Twigs smooth, light green, becoming yellow, finally dark gray-brown and rough with the persistent bases of fallen leaves; thin, red-brown on the trunk, with broad, flat ridges and deepish furrows. Plate I.

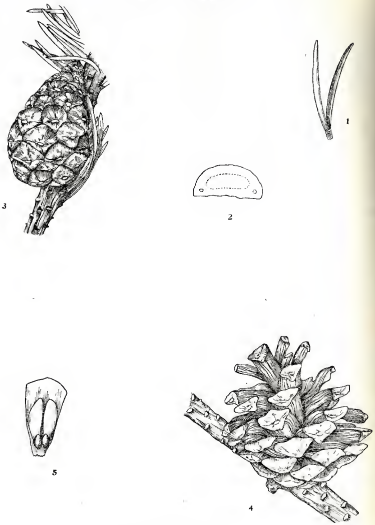
Wood.—Light, soft, weak, brittle, coarse-grained, very durable, light brown or red, with thick, yellowish to whitish sapwood.

Distribution.—Common in the northern portion of the Champlain Valley, especially along the lower courses of the Winooski, Lamoille and Missisquoi Rivers; less common in the Connecticut Valley as far north as Wells River.

Habitat.—Barren, sandy soil.

Notes.—This tree is a prolific seeder. It is able to sprout from the stump and is fire-resistant. In suitable places it forms dense groves of small trees, forty to sixty feet in height. The individual trees sometimes are picturesque but neither graceful nor very attractive in appearance. The branches even of the smaller trees mature numerous cones, which are long persistent. They are about two inches long, and, as has been said, they have scales tipped with sharp recurved prickles, a character which may aid in its recognition.

Gray Pine. Jack Pine



(Mich. Trees).

1. Cluster of leaves, x 1.
2. Cross-section of leaf, enlarged.
3. Branchlet with unopened cone, x 1.
4. Branchlet with opened cone, x 1.
5. Cone-scale with seeds, x 1.

PINACEAE

Gray Pine. Jack Pine

Pinus banksiana Lamb. [Pinus divaricata (Ait.) DuMont de Cours.]

Habit.—Usually a small tree 15-30 feet high, with a trunk diameter of 8-12 inches; forming usually a scrubby, stunted, and variously distorted crown.

Leaves.—In clusters of two; about 1 inch long; narrow-linear, with sharp-pointed apex; stout, curved or twisted, divergent from a short sheath; dark gray-green. Persistent 2-3 years.

Flowers.—May-June; monoecious; the staminate in oblong clusters ½ inch long, composed of many sessile, yellow anthers imbricated upon a central axis; the pistillate in subglobose clusters, composed of many carpel-like, purple scales (subtended by small bracts) spirally arranged upon a central axis.

Fruit.—Autumn of second or third season, but remaining closed for several years and persistent on the tree for 10-15 years; erect, usually incurved, oblong-conical, sessile cones, 1½-2 inches long; scales thickened at the apex; seeds triangular, nearly black, ⅜ inch long, with wings ⅓ inch long.

Winter-buds.—Terminal bud ¼ inch long, ovoid, rounded, pale brown; lateral buds smaller.

Bark.—Twigs yellow-green, becoming purple, finally dark red-brown and rough with the persistent bases of fallen leaves; thin, dark red-brown on the trunk, with shallow, rounded ridges, rough-scaly on the surface.

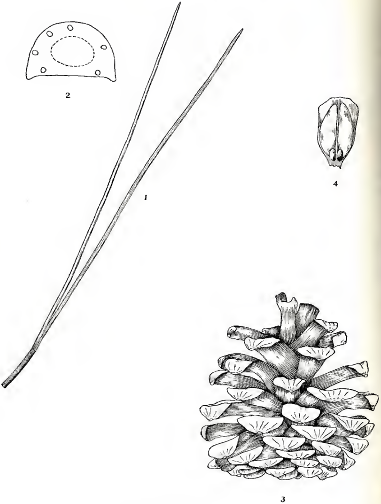
Wood.—Light, soft, weak, close-grained, light brown, with thick, whitish sapwood.

Distribution.—Reported at Monkton and Starksboro in Addison county and at Fairfax in Franklin county; but few trees at each station.

Habitat.—Sandy, sterile soil; rocky slopes.

Notes.—The gray pine is the smallest of the Vermont pines, with sprawling habit and short stout leaves, giving the tree a bristly, stunted appearance. Its characteristic cones are pointed and curved toward the main axis of the stem, often partially encircling it. The gray pine is a northern species extending to the Arctic region, and the line of its southeastern limit passes through northern Vermont. It is one of the rarest of our trees, and but few specimens are known to occur within our State borders. The remaining trees should be sought out and spared because of their scientific interest.

Red Pine. Norway Pine



(Mich. Trees).

1. Cluster of leaves, x 1.
2. Cross-section of leaf, enlarged.
3. Opened cone, x 1.
4. Cone-scale with seeds, x 1.

PINACEAE

Red Pine. Norway Pine

Pinus resinosa Ait.

HABIT.—A large tree 50-75 feet high, with a trunk diameter of 2-3 feet; stout, horizontal branches form a broad, rounded, rather open crown.

LEAVES.—In clusters of two; 4-6 inches long; slender, straight, needle-shaped, sharp-pointed, flexible, from elongated, persistent sheaths; lustrous dark green. Persistent 4-5 years.

FLOWERS.—April-May; monoecious; the staminate in oblong, dense clusters, ½-¾ inch long, composed of many sessile, purple anthers imbricated upon a central axis; the pistillate single or few-clustered at the end of the branchlets, subglobose; scales ovate, scarlet, borne on stout peduncles covered with pale brown bracts.

FRUIT.—Autumn of second season, falling the next summer; ovate-conical, nearly sessile cones, about 2 inches long; scales thickened at the apex; seeds oval, compressed, light mottled-brown, with wings ½-¾ inch long.

WINTER-BUDS.—About ¾ inch long, ovoid or conical, acute, red-brown, with rather loose scales.

BARK.—Twigs orange-brown, becoming rough with the persistent bases of leaf-buds; thick and red-brown on the trunk, shallowly fissured into broad, flat ridges. Plate I.

WOOD.—Light, hard, very close-grained, pale red, with thin, yellow to white sapwood. Page 217.

DISTRIBUTION.—Scattered groups or small groves occur on the dry, rocky headlands of Lake Champlain and it may be found in similar soils in the river valleys throughout Vermont, although it is less frequent in the southern counties.

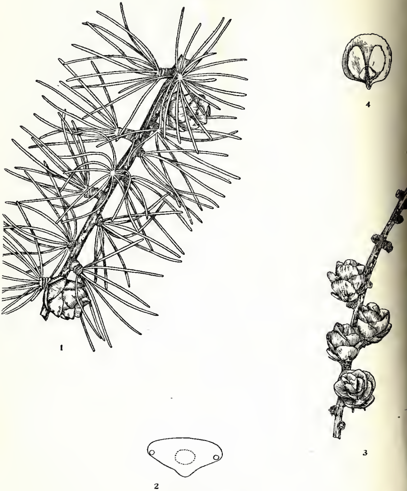
HABITAT.—Poor soils; sandy plains and dry woods.

NOTES.—The red pine makes a rapid growth on our better soils. It is difficult to transplant but should be used extensively.

The name "red pine" is appropriate both because of the pale red color of the heart wood and the distinctly reddish cast of the bark. This species does not grow in Norway or elsewhere in Europe, and it is said that it received the name from the town of Norway, Maine. The name "Norway pine" has so little fitness as applied to this tree, and evidently is so misleading that its use is to be discouraged.

The picturesqueness and individuality of the red pine commend it for wider use as an ornamental tree.

Tamarack



(Mich. Trees).

1. Autumn branchlet, with leaves and cones, x 1.
2. Cross-section of leaf, enlarged.
3. Fruiting branchlet in winter, x 1.
4. Cone-scale with seeds, x 2.

PINACEAE

Tamarack

Larix laricina (DuRoi) Koch [Larix americana Michx.]

Habit.—A tree sometimes 80-100 feet high, with a trunk diameter of 1-2 feet; forming a broad, open, irregular crown of horizontal branches.

Leaves.—Scattered singly along the leading shoots or clustered on the short lateral branchlets; linear, with blunt apex; rounded above, keeled beneath; about 1 inch long; bright green; sessile. Deciduous in early autumn.

Flowers.—May, with the leaves; monoecious; the staminate sessile, subglobose, yellow, composed of many short-stalked anthers spirally arranged about a central axis; the pistillate oblong, short-stalked, composed of orbicular, green scales (subtended by red bracts) spirally arranged about a central axis.

Fruit.—Autumn of first season, but persistent on the tree for a year longer; ovoid, obtuse, light brown, short-stalked cones, ½-¾ inch long; seeds ⅛ inch long, with pale brown wings widest near the middle.

Winter-buds.—Small, globose, lustrous, dark red.

Bark.—Twigs at first grayish, glaucous, later light orange-brown, and finally dark brown; red-brown and scaly on the trunk. Plate I.

Wood.—Heavy, hard, very strong, coarse-grained, very durable, light brown, with thin, nearly white sapwood. Page 219.

Distribution.—Common throughout Vermont, except in the lower Connecticut valley.

Habitat.—Cold, deep swamps.

Notes.—The tamarack becomes a picturesque tree in old age. It grows slowly in swamps, but rapidly on well-drained soils. It is our only cone-bearing tree which drops its leaves in the autumn. The tamarack is an attractive, conical tree, its graceful form and full clusters of slender, delicate leaves giving it a well-marked individuality. Its deep red, fleshy cones, which open in June, resemble flower clusters.

THE SPRUCES

Every Vermonter should know and appreciate the spruces for the mountain spruce and the sugar maple are our most characteristic trees. The forests of North America contain seven species of spruce, three of which occur in Vermont.[1]

The spruces are northern trees, and Vermont lies rather south of the belt of their most abundant growth in northeastern America. It is therefore our mountain sides and cool swamps which furnish conditions suitable for their best development.

The flowering cones are similar to those of the pine in general characters. The flowers appear in spring and the cones mature the following autumn, the seeds being shed during autumn or early winter.

Until recently botanists considered the two species here described as the red spruce and the black spruce to be simply varieties of one species, to which was given the common name of black spruce. In the lumber trade all three kinds are handled, without discrimination, as "spruce." As a matter of fact, the red spruce furnishes nearly all of the spruce lumber cut in Vermont. Spruce gum also comes chiefly from the red spruce, although it is formed by the other species.

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[1] *Introduced species.*—The Norway spruce (*Picea abies*) is commonly cultivated in Vermont dooryards, parks and cemeteries, and is superior to our native trees for such purposes. It is recognized easily by its more pendulous branches and very large slender cones, five to seven inches long.

The Colorado blue spruce (*P. pungens*) is occasionally planted. This is characterized by its beautiful glaucous-blue foliage. The cones are three to five inches long.

SUMMER AND WINTER KEY TO THE SPECIES OF PICEA

a. Leaves ⅛-⅝ inch long; twigs conspicuously pubescent.

b. Leaves usually ⅛-⅜ inch long, typically blunt-pointed, dark blue-green; cones about 1 inch long, persistent on the branches for many years, their scales ragged-toothed; tree typical of swamps .... **P. mariana,** p. 43.

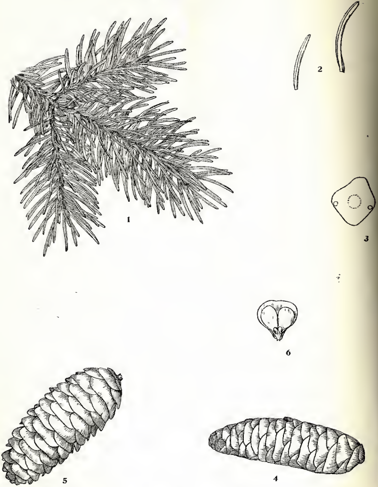
bb. Leaves ⅜-⅝ inch long, typically sharp-pointed, dark yellow-green; cones 1¼-2 inches long, falling mostly during their first winter, their scales not ragged-toothed; tree typical of well-drained uplands and rocky slopes............ **P. rubra,** p. 41.

aa. Leaves ⅝-1 inch long; twigs not conspicuously pubescent, usually glabrous.

b. Cones 1-2 inches long, maturing and falling in first season, their scales not toothed; leaves ill-scented when bruised, **P. canadensis,** p. 39.

bb. Cones 3-6 inches long, maturing and falling in second season, their scales finely toothed; leaves not ill-scented when bruised, **P. abies,** p. 45.

White Spruce



(Mich. Trees).

1. Winter branchlet, x 1.
2. Leaves, x 1.
3. Cross-section of leaf, enlarged.
4. Unopened cone, x 1.
5. Partly opened cone, x 1.
6. Cone-scale with seeds, x 1.

PINACEAE

White Spruce

Picea canadensis (Mill.) BSP. [Picea alba Link]

HABIT.—A tree 70-100 feet high, with a trunk diameter of 1-3 feet; forming a rather broad, open, pyramidal crown.

LEAVES.—Spirally arranged, but crowded on the upper side of the branches by the twisting of those on the under side; awl-shaped, 4-sided, incurved; dark blue-green; about ¾ inch long; ill-scented when bruised. Persistent for several years.

FLOWERS.—May; monoecious; the staminate in oblong-cylindrical, long-stalked clusters, ½-¾ inch long, composed of many spirally arranged, red anthers; the pistillate in oblong-cylindrical clusters, composed of broad, reddish scales (subtended by orbicular bracts) spirally arranged upon a central axis.

FRUIT.—Autumn or early winter of first season, falling soon after discharging the seeds; pendent, slender, oblong-cylindrical, nearly sessile cones, 1-2 inches long; seeds about ⅛ inch long, with large wings oblique at the apex.

WINTER-BUDS.—Broadly ovoid, obtuse, light brown, ⅛-¼ inch long.

BARK.—Twigs smooth, gray-green, becoming orange-brown, finally dark gray-brown; thin, light gray-brown on the trunk, separating into thin, plate-like scales.

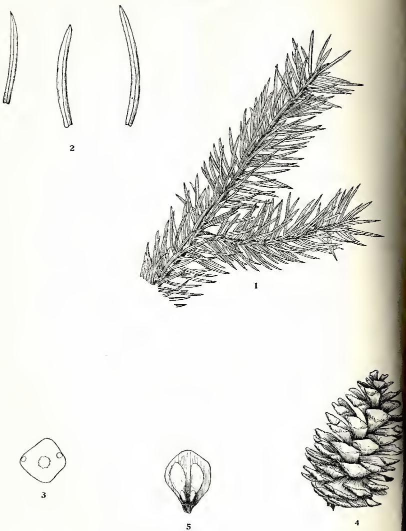
WOOD.—Light, soft, weak, straight-grained, light yellow, with sapwood of the same color.

DISTRIBUTION.—Common in the northeastern quarter of Vermont; also on some of the islands of Lake Champlain; has been reported from other isolated districts.

HABITAT.—Low, damp woods; banks of streams; borders of lakes; high, rocky or sandy slopes.

NOTES.—This is a northern tree which extends from Canada into northern Vermont. It occurs along the Connecticut river to the Fifteen Mile Falls (South Lunenburg), and on the eastern arm of the Y of the Green Mountains to the Montpelier and Wells River railroad, or perhaps a little farther south. It is common on some of the islands of Lake Champlain and is scattered through the forests of Essex county. The strong polecat odor of the young branches is characteristic and will aid in its recognition. Because of this odor it is sometimes called "skunk spruce." Lumbermen do not separate this from the other spruces and the tree is nearly equal in size to the red spruce.

Red Spruce



1. Winter branchlet, x 1.
2. Leaves, x 2.
3. Cross-section of leaf, enlarged.
4. Opened cone, x 1.
5. Cone-scale with seeds, x 1.

PINACEAE

Red Spruce

Picea rubra (DuRoi) Dietr. [Picea rubens Sarg.]

HABIT.—A tree 50-80 feet high, with a trunk diameter of 1-3 feet; forming a narrow, conical crown of slender, spreading branches reaching nearly to the ground; when crowded, usually lacking branches for much of its length.

LEAVES.—Spirally arranged, pointing outward in all directions; awl-shaped, 4-sided, mostly sharp or thickly taper-pointed, more or less incurved; slender; lustrous, dark yellow-green; ⅜-⅝ inch long. Persistent for several years.

FLOWERS.—May; monoecious; the staminate in ovoid clusters, about ½ inch long, composed of many spirally arranged, bright red anthers; the pistillate in oblong-cylindrical clusters, ¾ inch long, composed of thin, rounded, purple scales (subtended by small, obovate bracts) spirally arranged upon a central axis.

FRUIT.—Autumn of first season, falling mostly during their first winter; pendent, elongate-ovoid, short-stalked cones, 1¼-2 inches long; seeds about ⅛ inch long, dark brown, with short, broad wings.

WINTER-BUDS.—Ovoid, acute, light red-brown, puberulous, about ³⁄₁₆ inch long.

BARK.—Twigs at first greenish, with dense, whitish pubescence, becoming light brown and rusty-pubescent; thin, red-brown on the trunk, flaky with thin scales.

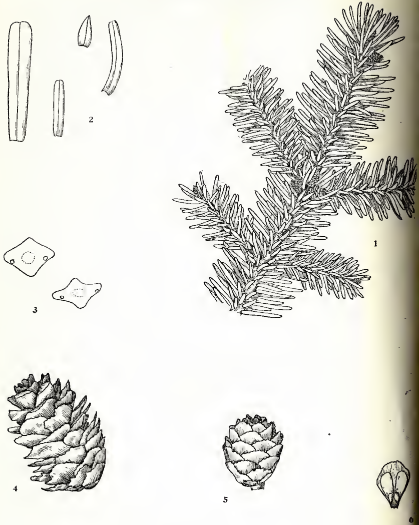
WOOD.—Light, soft, weak, close-grained, pale and tinged with red, with thin, paler sapwood. Page 217.

DISTRIBUTION.—Common throughout Vermont especially on the mountain slopes.

HABITAT.—Well-drained uplands; rocky slopes with thin soil; sometimes extending down to the borders of swamps.

NOTES.—This is the common spruce of our mountain forests, the vast green expanse of which suggested the names of both mountain range and State. It is not distinguished commonly from the preceding species and both are known as "black spruce." It attains a height of from seventy to one hundred feet and large logs may be three or more feet in diameter. When growing in open fields it often forms a conical head with the branches, especially of the younger trees, brushing the ground. It frequently is planted as an ornamental tree in Vermont, but its slower growth and less symmetrical form make it less desirable for this purpose than the native white spruce or Norway spruce.

Swamp Spruce. Black Spruce



(Mich. Trees).

1. Winter branchlet, x 1.
2. Leaves, x 2.
3. Cross-sections of leaves, enlarged.

4-5. Opened cones, x 1.

6. Cone-scale with seeds, x 1.

PINACEAE

Swamp Spruce. Black Spruce

Picea mariana (Mill.) BSP. [Picea nigra Link]

HABIT.—A small tree 20-50 feet high, with a trunk diameter of 6-12 inches; forming a narrow-based, conical, more or less irregular crown of short, slender, horizontal branches; often small and stunted.

LEAVES.—Spirally arranged, spreading in all directions; awl-shaped, 4-sided, blunt at the apex, more or less incurved; stiff; dark blue-green and glaucous; 1/8-3/8 inch long. Persistent for several years.

FLOWERS.—May; monoecious; the staminate in subglobose clusters, about 1/2 inch long, composed of many spirally arranged, dark red anthers; the pistillate in oblong-cylindrical clusters, composed of broad, purple scales (subtended by rounded, toothed, purple bracts) spirally arranged upon a central axis, about 1/2 inch long.

FRUIT.—Autumn of first season, but persistent on the branch for many years; pendent, ovoid, short-stalked cones, about 1 inch long; seeds about 1/8 inch long, with pale brown wings 1/2 inch long.

WINTER-BUDS.—Ovoid, acute, light red-brown, puberulous, 1/8 inch long.

BARK.—Twigs at first green and rusty-pubescent, becoming dull red-brown and rusty-pubescent; thin, gray-brown on the trunk, separating into thin, appressed scales.

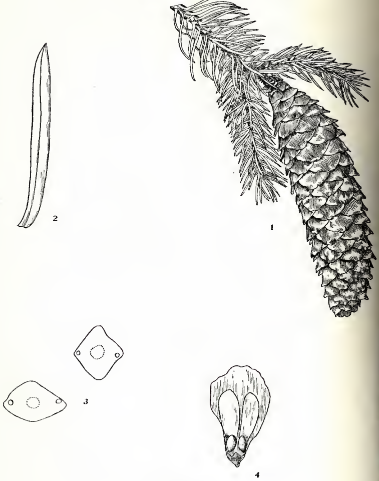
WOOD.—Light, soft, weak, pale yellow-white, with thin, pure white sapwood.

DISTRIBUTION.—This is the common spruce of the sphagnum (peat moss) swamps of the Champlain valley. It is also common in Essex and Franklin counties and probably occurs similarly in the other parts of Vermont, especially in peat bogs, but the distribution is not well known because of its confusion until recently with the red spruce.

HABITAT.—Cold, sphagnous bogs and swamps; shores of lakes.

NOTES.—The black spruce is short-lived. It is undesirable for ornamental planting, as the lower branches die early, making an unattractive evergreen. A small, semi-prostrate, sterile form, *Picea mariana, forma semiprostrata,* occurs on the summit of Mt. Mansfield.

Norway Spruce



(Mich. Trees).

1. Branchlet with partly opened cone, x½.
2. Leaf, x 3.
3. Cross-sections of leaves, enlarged.
4. Cone-scale with seeds, x 1.

PINACEAE

Norway Spruce

Picea abies (L.) Karst. [Picea excelsa Link]

HABIT.—A tree 50-70 feet high, with a trunk diameter of 1-3 feet; forming a dense, conical, spire-topped crown of numerous, drooping branches which persist nearly to the ground.

LEAVES.—Spirally arranged along the twig; crowded; ¾-1 inch long; rigid, curved, acute; lustrous, dark green. Persistent 5-7 years.

FLOWERS.—May; monoecious; the staminate in ovoid to subglobose clusters, long-stalked, reddish to yellowish, ¾-1 inch long; the pistillate in cylindrical clusters, sessile, erect, 1½-2 inches long.

FRUIT.—Autumn of second season; sessile, cylindrical cones 3-6 inches long, pendent from the tips of the uppermost branches; sterile scales very short, toothed; seeds red-brown, rough, ⅛ inch long, with long wings.

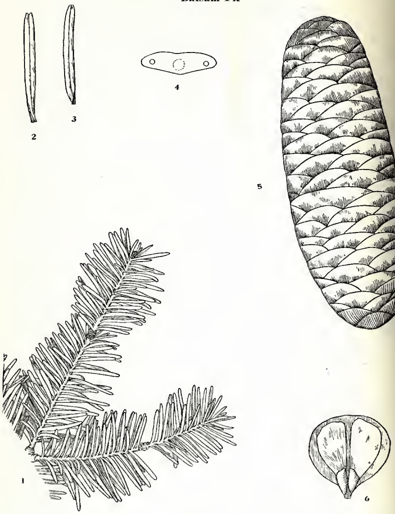
WINTER-BUDS.—Ovoid, acute, red-brown, not resinous, about ⅜ inch long.

BARK.—Twigs red- or orange-brown, smooth or corrugated; becoming thin and gray-brown on old trunks, slightly fissured, scaly.

WOOD.—Light, strong, tough, elastic, soft, fined-grained, white, with thick, indistinguishable sapwood.

NOTES.—This tree is native throughout northern Europe and Asia where it grows to a height of 120 to 150 feet. It is perfectly hardy here and is the common spruce found in dooryards throughout Vermont. As it adapts itself to a variety of soils and climates and grows rapidly, it is especially desirable for ornamental planting, hedges and windbreaks. One of the best known plantations of this spruce is a small area on the Billings estate at Woodstock, which was planted nearly 40 years ago.

Balsam Fir



(Mich. Trees).

1. Winter branchlet, x 1.
2-3. Leaves, x 2.
4. Cross-section of leaf, enlarged.
5. Unopened cone, x 1.
6. Cone-scale with seeds, x 1.

PINACEAE

Balsam Fir

Abies balsamea (L.) Mill.

HABIT.—A slender tree 40-60 feet high, with a trunk diameter of 12-18 inches; branches in whorls of 4-6, forming a symmetrical, open crown widest at the base and tapering regularly upward.

LEAVES.—Scattered, spirally arranged in rows, on young trees at right angles to the branch, on old trees covering the upper side of the branch; narrowly linear, with apex acute or rounded; ½-1¼ inches long; lustrous, dark green above, pale beneath; sessile; aromatic. Persistent 8-10 years.

FLOWERS.—May; monoecious; the staminate oblong-cylindrical, yellow, ¼ inch long, composed of yellow anthers (subtended by scales) spirally arranged upon a central axis; the pistillate oblong-cylindrical, 1 inch long, composed of orbicular, purple scales (subtended by yellow-green bracts) spirally arranged upon a central axis.

FRUIT.—Autumn of first season; oblong-cylindrical, erect, puberulous, dark purple cones, 2-4 inches long, about 1 inch thick; seeds ¼ inch long, shorter than their light brown wings.

WINTER-BUDS.—Globose, orange-green, resinous, ⅛-¼ inch in diameter.

BARK.—Twigs at first grayish and pubescent, becoming gray-brown and smooth; thin and smooth on young trunks, pale gray-brown and marked by swollen resin chambers; red-brown on old trunks and somewhat roughened by small, scaly plates.

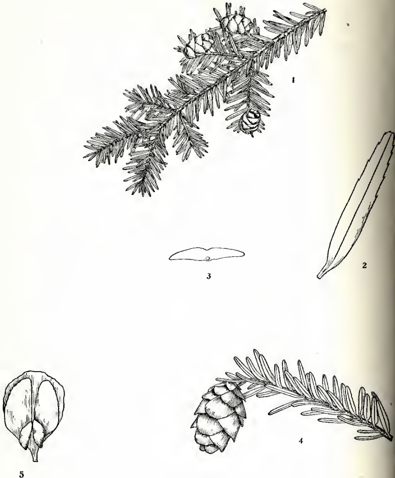
WOOD.—Very light, soft, weak, coarse-grained, perishable, pale brown, with thick, lighter colored sapwood. Page 221.

DISTRIBUTION.—Common in the mountain forests throughout Vermont, ascending to the summits of Mt. Mansfield and Camel's Hump, although there it is reduced to a low, scrubby growth; not reported in the Connecticut valley south of Hartland.

HABITAT.—Cold, wet woods and swamps, in the higher altitudes.

NOTES.—The balsam fir, more familiarly known as the fir tree or balsam, is a slender, graceful tree when growing in open ground. It bears a general resemblance to the spruces, but is distinguished easily from them on close observation. The leaves are flat, gray on the under side, with a conspicuous green midrib. The erect cones, 2 to 4 inches long, stand like Christmas candles on the upper branches. There is a characteristic fragrance from the bruised leaves and they are much prized for making pillows.

Hemlock



(Mich. Trees).

1. Fruiting branch viewed from beneath, x ½.
2. Leaf, x 3.
3. Cross-section of leaf, enlarged.
4. Branchlet with partly opened cone, x 1.
5. Cone-scale with seeds, x 3.

PINACEAE

Hemlock

Tsuga canadensis (L.) Carr.

HABIT.—A large tree 60-80 feet high, with a trunk 2-4 feet in diameter; forming a rather broad, open, somewhat irregular-pyramidal crown of slender, horizontal branches.

LEAVES.—Spirally arranged around the branch, but appearing 2-ranked by the twisting of their petioles; linear, flat, rounded at the apex; about ½ inch long; dark yellow-green and shining above, hoary beneath; short-petioled. Persistent about 3 years.

FLOWERS.—May; monoecious; the staminate axillary, short-stalked, light yellow, about ⅜ inch long, composed of subglobose clusters of stamens; the pistillate terminal, oblong, pale green, ⅛ inch long, the scales short, pinkish.

FRUIT.—Autumn of first season, gradually losing their seeds during the winter and falling the next spring; oblong-ovoid, acute, short-stalked, red-brown cones, about ¾ inch long; seeds ⅛ inch long, with wings about twice as long.

WINTER-BUDS.—Ovoid, obtuse, red-brown, slightly puberulous, 1/16 inch long.

BARK.—Twigs at first pale brown and pubescent, becoming glabrous, gray-brown; thick, red-brown or gray on the trunk, deeply divided into narrow, rounded, scaly ridges. Plate II.

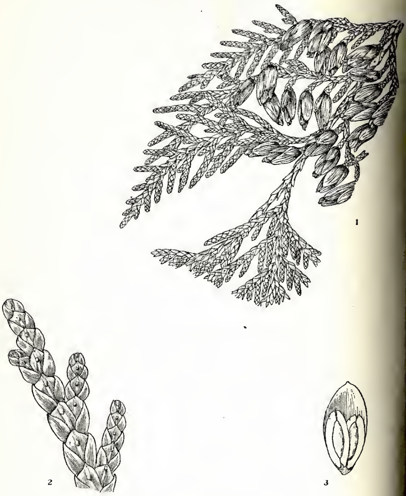
WOOD.—Light, soft, weak, brittle, coarse, and crooked-grained, not durable, ill-smelling, light red-brown, with thin, darker colored sapwood. Page 219.

DISTRIBUTION.—Common throughout Vermont, especially in the mountain forests.

HABITAT.—Rocky woods and hillsides; borders of swamps; mountain forests; low river-banks.

NOTES.—The hemlock is one of the most graceful of our evergreen trees. It may be met with almost everywhere from the low river-banks and swamps to the rocky hillsides and mountain forests. In distinguishing the hemlock from the spruce and balsam fir, one should notice the flat, petioled leaves arranged in a flattened spray with a row on the upper side lying close to the stem. The small ellipsoidal cones, scarcely more than three-fourths of an inch long, mature in the autumn and shed their seeds during the winter.

Arbor Vitae. White Cedar



(Mich. Trees).

1. Fruiting branchlet, x 1.
2. Tip of branchlet, enlarged.
3. Cone-scale with seeds, x 3.

PINACEAE

Arbor Vitae. White Cedar

Thuja occidentalis L.

HABIT.—A tree 40-50 feet high, with a short, often buttressed trunk 1-2 feet in diameter, often divided into 2-3 secondary stems; forming a rather dense, wide-based, pyramidal crown.

LEAVES.—Opposite, 4-ranked, scale-like, appressed; ovate, obtuse or pointed, keeled in the side pairs, flat in the others; ⅛-¼ inch long; yellow-green, often becoming brown in winter; strongly aromatic when crushed. Persistent 1-2 years.

FLOWERS.—April-May; usually monoecious; the staminate minute, globose, yellow, composed of 4-6 stamens arranged oppositely on a short axis; the pistillate small, oblong, reddish, composed of 8-12 scales arranged oppositely on a short axis.

FRUIT.—Early autumn of first season, but persistent on the branch through the winter; erect, short-stalked, oblong-ovoid, pale brown cones, about ½ inch long, composed of 8-12 loose scales; seeds ⅛ inch long, ovate, acute, winged.

WINTER-BUDS.—Naked, minute.

BARK.—Twigs, yellow-green, becoming light red, finally smooth, lustrous, dark orange-brown; thin, light red-brown on the trunk, slightly furrowed or deciduous in ragged strips.

WOOD.—Light, soft, brittle, rather coarse-grained, durable, fragrant, pale yellow-brown, with thin, whitish sapwood. Page 221.

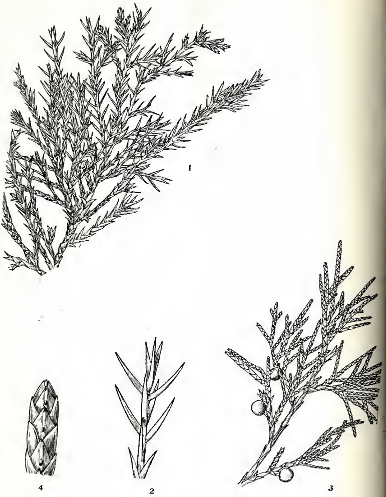
DISTRIBUTION.—Common in northern and central Vermont, and as far south as Woodstock and Hartland in eastern Vermont, up to 1,000 feet altitude.

HABITAT.—Swamps and along river-banks; rocky slopes; cool, moist hillsides.

NOTES.—This tree is known popularly in Vermont as the white cedar and is recognized easily by its striking pyramidal habit of growth and, upon closer examination, by its small scale-like leaves, in four rows but so flattened on the branchlets as to form fan-like sprays.

The straight slender trunks of this species are of especial value for posts and telegraph poles. Few timbers better withstand decay in the soil, fence posts sometimes lasting thirty or forty years. It is planted commonly for hedges and other ornamental purposes.

Red Cedar



(Mich. Trees).

1. Branchlet with awl-shaped leaves, x 1.
2. Tip of branchlet, showing awl-shaped leaves, enlarged.
3. Fruiting branchlet with scale-like leaves, x 1.
4. Tip of branchlet, showing scale-like leaves, enlarged.

PINACEAE

Red Cedar

Juniperus virginiana L.

Habit.—A medium-sized tree 30-40 feet high, with a trunk diameter of a foot; forming an irregular, pyramidal or rounded crown.

Leaves.—Opposite, of two kinds: (1) sessile, scale-like, closely appressed, overlapping, 4-ranked, ovate, acute, 1/16 inch long, (2) sessile, awl-shaped, loosely-arranged, 1/4-1/2 inch long. Persistent 5-6 years.

Flowers.—May; usually dioecious; minute; the staminate oblong-ovoid, composed of 4-6 shield-like scales, each bearing 4-5 yellow, globose pollen sacs; the pistillate ovoid, composed of about 3 pairs of fleshy, bluish scales, united at the base and bearing 2 ovules.

Fruit.—Autumn of first or second season; subglobose, berry-like strobile, about 1/4 inch in diameter, dark blue and glaucous; flesh sweet and resinous; seeds 2-3.

Winter-buds.—Naked, minute.

Bark.—Twigs greenish to red-brown and smooth; thin, light red-brown on the trunk, exfoliating lengthwise into long, narrow, persistent strips, exposing the smooth, brown inner bark.

Wood.—Light, soft, close-grained, brittle, weak, durable, very fragrant, dull red, with thin, whitish sapwood.

Distribution.—Common in lower altitudes of western Vermont, less so in the mountain range of southwestern Vermont; more or less common in the Connecticut valley as far north as Fairlee.

Habitat.—Dry, rocky hills; also borders of lakes and streams, peaty swamps.

Notes.—Three kinds of juniper are found in Vermont, but this one, commonly known as "red cedar," is the only one which has the size and habit of a tree. It somewhat resembles the arbor vitæ, from which it may be distinguished at a distance by its less symmetrical form and darker foliage. Closer inspection shows that its scale-like leaves have little tendency to the arrangement in a plane which is characteristic of the arbor vitæ. The fruit also is distinguishable readily from that of the other cone-bearing trees. It consists of thick, fleshy scales which coalesce to form a structure looking more like a small berry than a cone, green in midsummer, becoming bluish at maturity in the autumn. The leaves of young shoots are longer than those on the older branches, with needle-like points. The heartwood of this tree is soft, red and fragrant, and that obtained from the southern states is largely used in the manufacture of pencils.

SALICACEAE—WILLOWS

The classification of the willows is a task for the specialist, even when leaves and both staminate and pistillate flowers are obtainable. For this reason the usual summer and winter keys have been omitted.

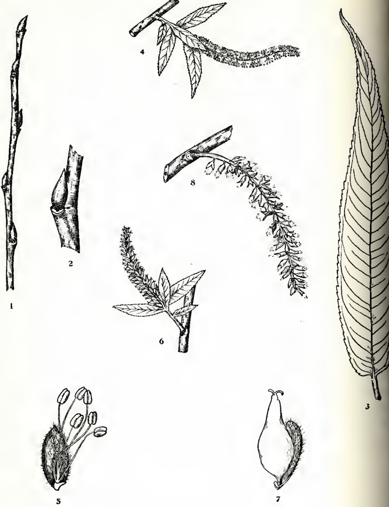
SALICACEAE

THE WILLOWS

The genus *Salix* is represented in Vermont by 25 distinct species or varieties and by a number of hybrids. The majority of these are shrubs, only a few becoming truly arborescent. Because of the similarity of their botanical characters, the frequency with which they hybridize, and the facility with which they respond to their environment, only an expert is competent to identify the species so abundant along our water courses and on the banks of our lakes and swamps. The scope of this work necessarily being limited, it has been deemed best to describe but one of our native willows and one of our foreign neighbors which is planted frequently.

Willows are introduced commonly as shade trees because they are propagated so easily by cuttings. Care should be taken, however, to select the stamen-bearing trees, both because these are more ornamental when in flower and because they do not produce the downy fruit which often is disagreeable when willows are growing near houses.

Black Willow



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Staminate flowering branchlet, x 1.
5. Staminate flower, enlarged.
6. Pistillate flowering branchlets, x 1.
7. Pistillate flower, enlarged.
8. Fruiting branchlet, x 1.

SALICACEAE

Black Willow

Salix nigra Marsh.

HABIT.—A tree 30-50 feet high, with a short trunk, 1-2 feet in diameter; stout, spreading branches form a broad, rather irregular, open crown. Often a shrub.

LEAVES.—Alternate, simple, 3-6 inches long, ¼-¾ inch broad; lanceolate, very long-pointed, often curved at the tip; finely serrate; thin; bright green and rather lustrous above, paler and often hairy beneath; petioles very short, more or less pubescent.

FLOWERS.—May, with the leaves; dioecious; borne in crowded, slender, hairy catkins, 1-3 inches long; calyx 0; corolla 0; scales yellow, villous, with 3-6 stamens; ovary ovoid-conical, short-stalked, with stigmas nearly sessile.

FRUIT.—June; ovoid-conical capsule, ⅛ inch long, containing many minute seeds which are furnished with long, silky, white hairs.

WINTER-BUDS.—Terminal bud absent; lateral buds narrow-conical, acute, lustrous, red-brown, ⅛ inch long.

BARK.—Twigs glabrous or pubescent, bright red-brown, becoming darker with age; thick, dark brown or nearly black on old trunks, deeply divided into broad, flat ridges, often becoming shaggy.

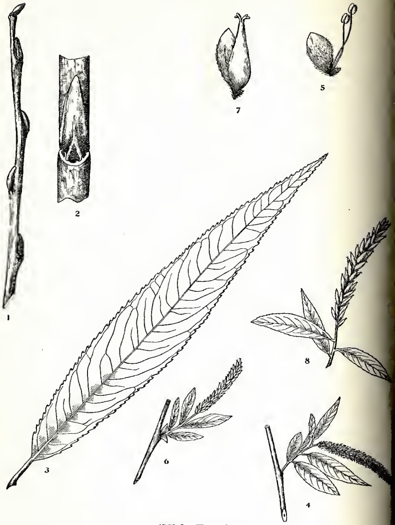
WOOD.—Light, soft, weak, close-grained, light red-brown, with thin, whitish sapwood.

DISTRIBUTION.—Common throughout Vermont.

HABITAT.—Banks of streams and ponds; lake-shores.

NOTES.—The black willow is a slender, rather graceful tree, common everywhere along the banks of lakes and streams. It may be recognized usually by its stouter dark brown or black twigs in contrast with the more slender, yellowish or bluish-green twigs of the European species. When the pendulous catkins open, three to five or more stamens may be found in each tiny flower. The leaves are green when mature and smooth except on the mid veins and petioles. The branchlets are very brittle at the base, and these, broken off by the wind, are carried down stream, often catching in the muddy banks and there taking root.

Crack Willow



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Staminate flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flowering branchlet, x ½.
7. Pistillate flower, enlarged.
8. Fruiting branchlet, x ½.

SALICACEAE

Crack Willow

Salix fragilis L.

Habit.—A tree 50-60 feet high, with a short, stout trunk 3-4 feet in diameter; stout, spreading branches form a broad, open crown.

Leaves.—Alternate, simple, 3-6 inches long, ½-1½ inches broad; lanceolate, long-pointed; finely glandular-serrate; thin and firm; lustrous, dark green above, paler beneath, glabrous both sides; petioles short, stout, with 2 glands at the junction of blade and petiole.

Flowers.—May, with the leaves; dioecious; borne in slender, pubescent catkins 1-3 inches long; calyx 0; corolla 0; scales blunt, somewhat pubescent; stamens usually 2; ovary abortive, with stigmas nearly sessile. Staminate trees rare.

Fruit.—May-June; 1-celled, long-conical, short-stalked capsule, about ¼ inch long, containing many minute seeds which are furnished with long, silky, white hairs.

Winter-buds.—Terminal bud absent; lateral buds long-conical, pointed, glabrous, bright red-brown, about ¼ inch long.

Bark.—Twigs pubescent, yellow-green, often reddish, becoming glabrous, lustrous, brown; thick, gray on the trunk, smooth in young trees, very rough, irregularly scaly-ridged in old trees.

Wood.—Light, soft, tough, close-grained, red-brown, with thick, whitish sapwood.

Notes.—This willow is a native of Europe and Asia, where it is a valuable timber tree. It is commonly cultivated and frequently escapes. The crack willow is hardy throughout Vermont, of very rapid growth, and thrives in rich, damp soil. The twigs are very brittle at the base and are broken easily by the wind, hence the name "crack willow."

THE POPLARS

The genus *Populus* belongs to the willow family and resemble the willows, especially in flower and fruit characters. The nodding, worm-like, staminate and pistillate catkins are borne upon different trees, and opening before the leaves, are conspicuous in early spring. The poplars are distributed quite widely, extending from the Arctic Circle to Mexico and from the Atlantic to the Pacific.

The wood of poplars is very soft and light and especially liable to warp, but is cheap and useful for making toys, boxes and smaller furniture. Much of it now goes to the pulp mills.

SUMMER KEY TO THE SPECIES OF POPULUS

a. Leaf-petioles essentially terete.
 b. Petioles and lower sides of leaves pubescent; leaves heart-shaped ....**P. candicans,** p. 71.
 bb. Petioles and lower sides of leaves glabrous; leaves ovate-lanceolate ....**P. balsamifera,** p. 69.
aa. Leaf-petioles strongly flattened.
 b. Petioles and lower sides of leaves tomentose; twigs pubescent, **P. alba,** p. 63.
 bb. Petioles and lower sides of leaves glabrous; twigs glabrous.
  c. Leaves distinctly deltoid in shape.
   d. Leaves broader than they are long, abruptly acuminate at the apex; marginal teeth not conspicuously incurved; branches erect and more or less appressed to the main stem, forming a narrow, spire-like crown.**P. nigra italica,** p. 75.
   dd. Leaves longer than they are broad, more or less taper-pointed at the apex; marginal teeth rather conspicuously incurved; branches spreading, forming a broad crown. **P. deltoides,** p. 73.
  cc. Leaves ovate to nearly orbicular in shape.
   d. Margin of leaves coarsely sinuate-toothed; leaves 3-5 inches long ....**P. grandidentata,** p. 67.
   dd. Margin of leaves finely serrate; leaves less than 3 inches long ....**P. tremuloides,** p. 65.

WINTER KEY TO THE SPECIES OF POPULUS

a. Branches erect, more or less appressed to the main stem, forming a narrow, spire-like crown.............. **P. nigra italica,** p. 75.

aa. Branches spreading, forming a broad crown.

b. Terminal buds ⅛-¼ inch long, not resinous.

c. Buds and twigs more or less conspicuously white-downy; twigs green .... **P. alba,** p. 63.

cc. Buds and twigs not conspicuously white-downy; twigs usually red-brown.

d. Terminal buds about ⅛ inch long, puberulous, dusty-looking; lateral buds widely divergent; twigs rather coarse .... **P. grandidentata,** p. 67.

dd. Terminal buds about ¼ inch long, glabrous, lustrous; lateral buds more or less appressed; twigs rather slender,
P. tremuloides, p. 65.

bb. Terminal buds ½-1 inch long, sticky-resinous.

c. Terminal buds about ½ inch long; buds not fragrant; twigs usually yellow, more or less strongly angled,
P. deltoides, p. 73.

cc. Terminal buds nearly 1 inch long; buds fragrant; twigs usually red-brown and seldom strongly angled,
P. balsamifera,[1] p. 69.
P. candicans,[1] p. 71.

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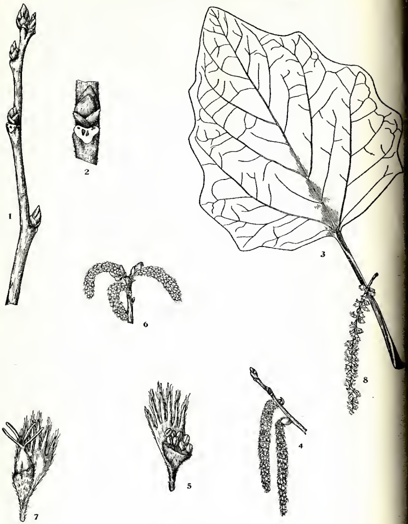
[1] It is difficult to distinguish between these species in the absence of summer characters. If leaves can be found on or beneath a tree which is sufficiently segregated from similar trees as to avoid any chance for error, the summer key on the opposite page may be used.

White Poplar. Silver-leaved Poplar



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 2.
4. Staminate flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flowering branchlet, x ½.
7. Pistillate flower, enlarged.
8. Fruit, x ½.

SALICACEAE

White Poplar. Silver-leaved Poplar

Populus alba L.

HABIT.—A large tree 50-75 feet high, with a trunk diameter of 2-4 feet, forming a large, spreading, rounded or irregular crown of large, crooked branches and sparse, stout branchlets.

LEAVES.—Alternate, simple, 2-4 inches long and almost as broad; broadly ovate to suborbicular; irregularly toothed, sinuate, or sometimes 3-5-lobed; glabrous, dark green above, white-tomentose to glabrous beneath; petioles long, slender, flattened, tomentose.

FLOWERS.—April-May, before the leaves; dioecious; the staminate catkins thick, cylindrical, 2-4 inches long; the pistillate catkins slender, 1-2 inches long; calyx 0; corolla 0; stamens 6-16, with purple anthers; stigmas 2, yellow.

FRUIT.—May-June; ovoid, 2-valved capsules, ⅛-¼ inch long, borne in drooping catkins 2-4 inches long; seeds light brown, surrounded by long, white hairs.

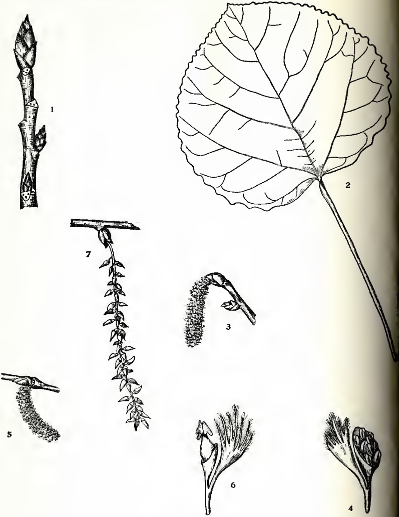
WINTER-BUDS.—Ovoid, pointed, not viscid, downy, about ¼ inch long.

BARK.—Twigs greenish, covered with a white down, becoming greenish gray and marked with darker blotches; dark gray and fissured at the base of old trunks.

WOOD.—Light, soft, weak, difficult to split, reddish yellow, with thick, whitish sapwood.

NOTES.—The white poplar is a native of Europe and Asia. It is hardy in Vermont, and is cultivated frequently, occasionally becoming an escape. It grows rapidly in good soils but thrives also in poor soils and in exposed situations. The deep roots produce numerous suckers for a considerable distance from the tree.

American Aspen. Trembling Poplar. Popple



(Mich. Trees).

1. Winter twig, x 2.
2. Leaf, x 1.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flowering branchlet, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

SALICACEAE

American Aspen. Trembling Poplar. Popple

Populus tremuloides Michx.

HABIT.—A small, slender tree generally 35-45 feet high, with a trunk diameter of 8-15 inches; forming a loose, rounded crown of slender branches.

LEAVES.—Alternate, simple, 1½-2½ inches long and broad; broadly ovate to suborbicular; finely serrate; thin and firm; lustrous, dark green above, dull and pale beneath; petioles slender, laterally compressed. Tremulous with the slightest breeze.

FLOWERS.—April, before the leaves; dioecious; the staminate catkins 1½-3 inches long, the pistillate at first about the same length, gradually elongating; calyx 0; corolla 0; stamens 6-12; stigmas 2, 2-lobed, red.

FRUIT.—May-June; 2-valved, oblong-cylindrical, short-pedicelled capsules ¼ inch long; seeds light brown, white-hairy.

WINTER-BUDS.—Terminal bud about ¼ inch long, narrow-conical. acute, red-brown, lustrous; lateral buds often appressed.

BARK.—Twigs very lustrous, red-brown, becoming grayish and roughened by the elevated leaf-scars; thin, yellowish or greenish and smooth on the trunk, often roughened with darker, horizontal bands or wart-like excrescences, becoming thick and fissured, almost black at the base of old trunks.

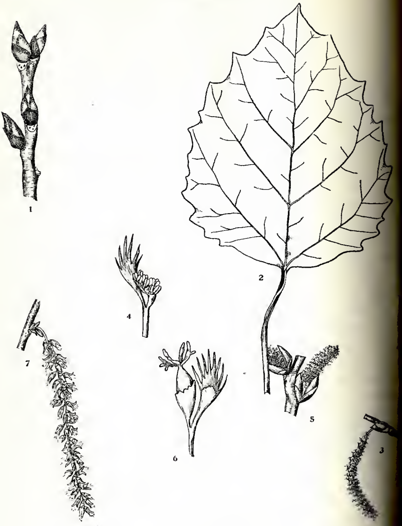
WOOD.—Light, soft, weak, close-grained, not durable, light brown, with thin, whitish sapwood. Page 229.

DISTRIBUTION.—Common throughout Vermont.

HABITAT.—Prefers moist, sandy soil and gravelly hillsides.

NOTES.—The most careless observer cannot have failed to notice the leaves of the aspen continually trembling on the quietest summer day. This tremulousness, indeed, has given name to the species. The reason for it, as may be seen readily by examination of any leaf, lies in the decidedly flattened structure of the leaf-stem or petiole. The slender drooping catkins appear in early spring and the downy fruits ripen in the latter part of May. The American aspen grows to a medium size, and is the most widely distributed tree in North America, extending from Labrador to Alaska, from Lower California to the Atlantic coast.

Large-toothed Aspen



(Mich. Trees).

1. Winter twig, x 2.
2. Leaf, x 1.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flowering branchlet, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

SALICACEAE

Large-toothed Aspen

Populus grandidentata Michx.

HABIT.—A medium-sized tree 30-50 feet high, with a slender trunk 12-20 inches in diameter; forming a loose, oval or rounded crown of slender, spreading branches and coarse spray.

LEAVES.—Alternate, simple, 3-5 inches long, two-thirds as broad; orbicular-ovate; coarsely and irregularly sinuate-toothed; thin and firm; dark green above, paler beneath, glabrous both sides; petioles long, slender, laterally compressed.

FLOWERS.—April-May, before the leaves; dioecious; the staminate in short-stalked catkins 1-3 inches long; the pistillate in loose-flowered, long-stalked catkins at first about the same length, but gradually elongating; calyx 0; corolla 0; stamens 6-12, with red anthers; stigmas 2, 2-lobed, red.

FRUIT.—May-June; 2-valved, conical, acute, hairy capsules ⅛ inch long, borne in drooping catkins 4-6 inches long; seeds minute, dark brown, hairy.

WINTER-BUDS.—Terminal bud ⅛ inch long, ovoid to conical, acute, light chestnut, puberulous, dusty-looking.

BARK.—Twigs greenish gray and at first hoary-tomentose, becoming lustrous, orange or red-brown and finally greenish gray; thick, dark red-brown or blackish at the base of old trunks, irregularly fissured, with broad, flat ridges.

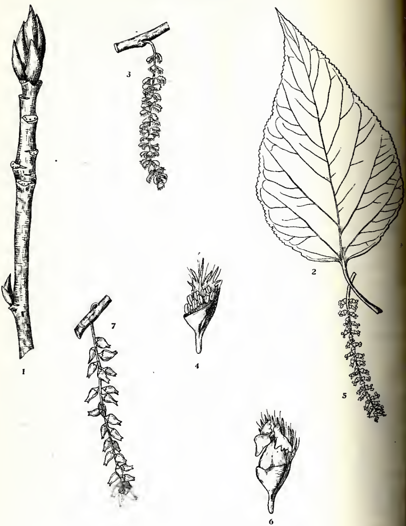
WOOD.—Light, soft, weak, close-grained, light brown, with thin, whitish sapwood.

DISTRIBUTION.—Frequent throughout Vermont.

HABITAT.—Prefers rich, moist, sandy soil; rich woods.

NOTES.—The name of this tree suggests an easy way of identifying it. The coarse-toothed margin of the leaf is a constant characteristic and may be relied upon. The pollen-bearing catkins are seen first, the ovule-bearing catkins appearing a little later on other trees. The fruits ripen when the leaves are unfolding. The young leaves are downy-white on both sides, but later become green and smooth.

Balsam Poplar. Tacamahac



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ¾.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Catkin of pistillate flower, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

SALICACEAE

Balsam Poplar. Tacamahac

Populus balsamifera L.

Habit.—A tree 50-75 feet high, with a trunk diameter of 1-3 feet; forming a rather narrow, open, pyramidal crown of few, slender, horizontal branches.

Leaves.—Alternate, simple, 3-6 inches long, about one-half as broad; ovate to ovate-lanceolate; finely crenate-serrate; thin and firm; lustrous, dark green above, paler beneath; petioles 1½ inches long, slender, terete, smooth.

Flowers.—April-May, before the leaves; dioecious; the staminate in long-stalked catkins 3-4 inches long; the pistillate in loose-flowered, long-stalked catkins 4-5 inches long; calyx 0; corolla 0; tamens 20-30, with bright red anthers; ovary short-stalked; stigmas 2, wavy-margined.

Fruit.—May-June; 2-valved, ovoid, short-pedicelled capsules ¼ nch long, borne in drooping catkins 4-6 inches long; seeds light brown, airy.

Winter-buds.—Terminal bud about 1 inch long, ovoid, long-ointed, brownish, resin-coated, sticky, fragrant.

Bark.—Twigs red-brown, becoming dark orange, finally green-ray; thick, grayish on old trunks, and shallowly fissured into broad, ounded ridges, often roughened by dark excrescences.

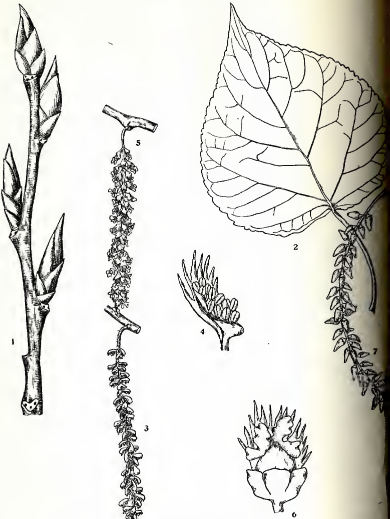
Wood.—Light, soft, weak, close-grained, light red-brown, with hick, nearly white sapwood.

Distribution.—Frequent throughout Vermont; often planted as shade tree.

Habitat.—Borders of streams and swamps; wet ravines.

Notes.—This tree is a northern species ranging from northern ew England to the Alaskan coast. It is subject to great variation the form of the leaves. Some are almost triangular with a deeply eart-shape base, while others are very slender with a wedge-shape ase. The buds and young leaves are covered with a gummy excretion hich sometimes is soaked out and used in preparing ointments. It often confused with *P. candicans*, p. 71.

Balm of Gilead



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ½.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flowering branchlet, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

SALICACEAE

Balm of Gilead

Populus candicans Ait. [Populus balsamifera candicans (Ait.) Gray]

HABIT.—A tree 50-70 feet high, with a trunk diameter of 1-3 feet; more spreading branches than in *P. balsamifera*, forming a broader and more open crown.

LEAVES.—Resemble those of *P. balsamifera*, but more broadly eart-shaped and more coarsely serrate; more or less pubescent when oung; petioles pubescent.

FLOWERS.—Similar to those of *P. balsamifera*.

FRUIT.—Similar to that of *P. balsamifera*.

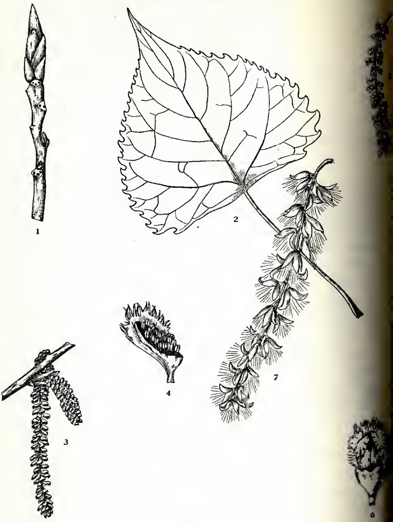
WINTER-BUDS.—Terminal bud about 1 inch long, ovoid, long-ointed, dark red-brown, resinous throughout, viscid, very aromatic.

BARK.—Twigs reddish or olive-green, with occasional longitudinal ray lines, covered with a fragrant, gummy secretion, becoming gray-reen; dark gray, rough, irregularly striate and firm on old trunks.

WOOD.—Resembles that of *P. balsamifera*, but is somewhat eavier.

NOTES.—The Balm of Gilead occasionally is cultivated and some-mes escapes to the roadsides. It was long confused with *P. bal-mifera*. Further investigation may show it to be a native along ur northern border. It grows rapidly in all soils and situations and reads rapidly by suckers from the roots.

Cottonwood. Necklace Poplar



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ½.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate catkin, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

SALICACEAE

Cottonwood. Necklace Poplar

Populus deltoides Marsh. [Populus monilifera Ait.]

HABIT.—A stately tree attaining a height of 70-90 feet and a trunk diameter of 3-5 feet; forming a spreading, open, symmetrical crown of massive, horizontal branches and stout, more or less angled branchlets.

LEAVES.—Alternate, simple, 3-6 inches long, nearly as broad; broadly deltoid-ovate; coarsely crenate-serrate above the entire base; thick and firm; lustrous, dark green above, paler beneath; petioles 2-3 inches long, slender, compressed laterally.

FLOWERS.—April-May, before the leaves; dioecious; the staminate in short-stalked, densely-flowered catkins 3-4 inches long; the pistillate in short-stalked, few-flowered catkins elongating to 6-8 inches; calyx 0; corolla 0; stamens very numerous, with red anthers; stigmas 3-4, spreading.

FRUIT.—May; 2-4-valved, short-stalked capsules, borne in drooping catkins 5-10 inches long; seeds light brown, densely cottony.

WINTER-BUDS.—Terminal bud ½ inch long, conical, acute, very resinous, shining, brownish.

BARK.—Twigs and young stems smooth, yellow-green; old trunks ashy gray, deeply divided into straight furrows with broad, rounded ridges.

WOOD.—Light, soft, weak, close-grained, dark brown, with thick, whitish sapwood; warps badly and is difficult to season.

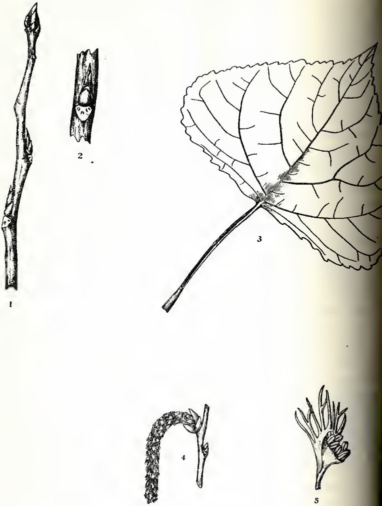
DISTRIBUTION.—Frequent in western Vermont.

HABITAT.—Prefers rich, moist soil, such as river-banks, river-bottoms or lake-shores; grows well in drier situations.

NOTES.—The cottonwood occurs native in the Champlain valley and along its tributary streams, and south in western Vermont to the Hoosic valley in Pownal, where it is particularly abundant. It occurs along the Connecticut river in southeastern Vermont at least as far north as Brattleboro. It has been planted as a shade tree in other localities usually under the name of "Carolina poplar." The stamen-bearing trees always should be chosen for this purpose since the abundant, cottony seed is a nuisance near dwellings.

The cottonwood is the most massive of our deciduous trees, sometimes reaching 100 feet in height and five to seven feet in diameter. Such isolated giants have become the familiar landmarks of many roadsides near Lake Champlain. It is a rapid-growing tree but short-lived and poorly adapted to street planting.

Lombardy Poplar



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ¾.
4. Staminate flowering branchlet, x ½.
5. Staminate flower, enlarged.

SALICACEAE

Lombardy Poplar

Populus nigra italica DuRoi [Populus fastigiata Desf.] [Populus dilatata Ait.]

HABIT.—A tree 75-100 feet high, with a short, ridged and buttressed trunk 4-6 feet in diameter and a narrow, spire-like crown of erect branches.

LEAVES.—Alternate, simple, 2-4 inches long, and usually somewhat broader than long; broad-deltoid, abruptly acuminate at the apex; finely but bluntly crenate-serrate; thick and firm; dark green and shining above, lighter and more or less lustrous beneath; petioles slender, laterally compressed, 1-2 inches long.

FLOWERS.—April-May, before the leaves; dioecious; the staminate in sessile, dark red, cylindrical catkins about 3 inches long; the pistillate not present in the United States; calyx 0; corolla 0; stamens about 8, with white filaments and purple anthers.

FRUIT.—Not formed in the United States in the absence of pistillate flowers.

WINTER-BUDS.—Terminal bud conical, slightly angled, taper-pointed, glutinous, about ⅜ inch long; lateral buds smaller, appressed.

BARK.—Twigs glabrous, shining yellow, becoming gray; thick and gray-brown on old trunks, deeply and irregularly furrowed.

WOOD.—Light, soft, easily worked, not liable to splinter, weak, not durable, light red-brown, with thick, nearly white sapwood.

NOTES.—This tree is thought to be a native of Afghanistan. It is frequently cultivated in Vermont and tends to spread by sprouting from the roots. It is used for ornamental purposes on account of its very rapid growth; but it is short-lived, its limbs die early, and these remain, causing the tree to become unsightly in a very few years.

THE WALNUTS

Every school boy in Vermont has some acquaintance at least the butternut and its sweet, tender nuts. It occurs along the sides and river-valleys throughout the State. The staminate flo appear in May and hang in graceful, slender catkins five or six long. These are generally found on the second-year shoots, while pistillate flowers are borne on the terminal shoots. Butternut show some irregularities, however, in reference to the time and of the appearance of the two kinds of flowers so that the pollen-b clusters may mature either some ten days earlier or later than the o bearing ones on the same tree. This may be the cause of the varia often noticed in the crop of butternuts. The peculiarity offers an teresting subject for further observation.

The meat of the butternut needs no recommendation, but the cellencies of pickles made from the young mucilaginous nuts are so well known. For this purpose they should be gathered earl June and the clammy pubescence removed by plunging them into ing water and rubbing with a coarse cloth.

The other member of this family, the black walnut, is not kn so well in Vermont. It is not a native tree in Vermont, althoug occurs occasionally in Southern New England, becoming more a dant southward and westward. It is planted often for orna uses and is a much better tree for this purpose than our native wa

SUMMER KEY TO THE SPECIES OF JUGLANS

a. Leaflets 11-17, the terminal usually present; pith of twigs chocolate-brown; bark of trunk rather smooth, or fissured, with broad, flat, whitish ridges; fruit elongated, sticky-downy. .**J. cinerea,** p. 79.

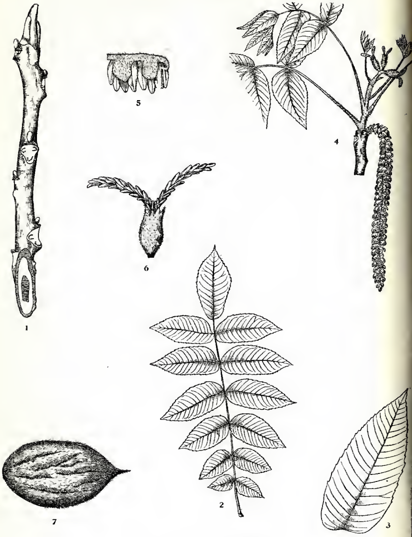
aa. Leaflets 13-23, the terminal often lacking; pith of twigs cream colored; bark of trunk rough, brownish or blackish, deeply furrowed by broad, rounded ridges; fruit globose, not sticky-downy,
J. nigra, p. 81.

WINTER KEY TO THE SPECIES OF JUGLANS

a. Pith chocolate-brown; leaf-scar with downy pad above; fruit elongated, sticky-downy; terminal bud ½-¾ inch long; bark rather smooth, or fissured, with broad, flat, whitish ridges,
J. cinerea, p. 79.

aa. Pith cream colored; leaf-scar without downy pad above; fruit globose, not sticky-downy; terminal bud ⅓ inch long; bark rough, brownish or blackish, deeply furrowed by broad, rounded ridges,
J. nigra, p. 81.

Butternut



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ⅙.
3. Leaflet, x ½.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

JUGLANDACEAE

Butternut

Juglans cinerea L.

Habit.—A medium-sized tree 30-50 feet high, with a short trunk 2-3 feet in diameter; forming a wide-spreading crown of large, horizontal branches and stout, stiff branchlets.

Leaves.—Alternate, compound, 15-30 inches long. Leaflets 11-17, 2-4 inches long and one-half as broad; sessile, except the terminal; oblong-lanceolate; finely serrate; thin; yellow-green and rugose above, pale and soft-pubescent beneath. Petioles stout, hairy.

Flowers.—May, with the leaves; monoecious; the staminate in cylindrical, greenish, drooping catkins 3-5 inches long; calyx 6-lobed, borne on a hairy bract; corolla 0; stamens 8-12, with brown anthers; the pistillate solitary or several on a common peduncle, about ⅓ inch long, their bracts and bractlets sticky-hairy; calyx 4-lobed, hairy; corolla 0; styles 2; stigmas 2, fringed, spreading, bright red.

Fruit.—October; about 2½ inches long, cylindrical, pointed. greenish, sticky-downy, solitary or borne in drooping clusters of 3-5; nuts with rough shells, inclosing a sweet, but oily kernel; edible.

Winter-buds.—Terminal bud ½-¾ inch long, oblong-conical, obliquely blunt, somewhat flattened, brownish, pubescent.

Bark.—Twigs orange-brown or bright green, rusty-pubescent, becoming smooth and light gray; gray and smoothish on young trunks, becoming brown on old trunks, narrow-ridged, with wide furrows. Plate II.

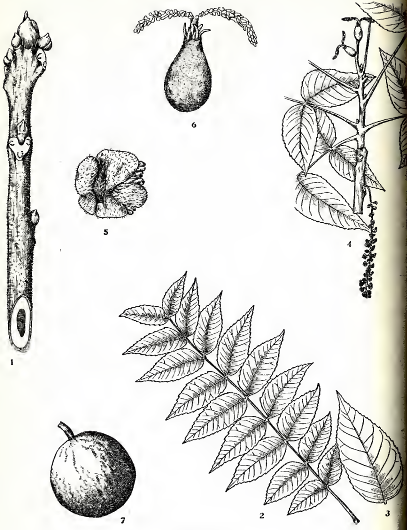
Wood.—Light, soft, weak, coarse-grained, light brown, with thin, lighter colored sapwood.

Distribution.—Of frequent occurrence throughout Vermont.

Habitat.—Prefers low, rich woods; river-banks; low hillsides; rocky hillsides.

Notes.—The leaves of the butternut appear late and fall early. The young trees are very attractive but the larger trees usually are scraggy and unsound. Some preliminary work done in Dorset, Bennington County, seems to indicate that perhaps through some peculiar root antagonism the butternut will kill the shrubby cinquefoil (*Potentilla fructicosa*), a shrub which is destroying some of the best pastures in Northwestern Connecticut, Berkshire County, Massachusetts and Bennington and Rutland Counties, Vermont.

Black Walnut



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ⅙.
3. Leaflet, x ½.
4. Flowering branchlet, x ½.
5. Staminate flower, back view, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

JUGLANDACEAE

Black Walnut

Juglans nigra L.

Habit.—A large tree 50-75 feet high, with a massive trunk 2-5 feet in diameter; forming an open, capacious crown of heavy branches and coarse branchlets.

Leaves.—Alternate, compound, 1-2 feet long. Leaflets 13-23, the terminal often lacking, 2-4 inches long and one-half as broad; sessile; ovate-lanceolate, taper-pointed; sharp-serrate; thin; yellow-green and glabrous above, lighter and soft-pubescent beneath. Petioles stout, pubescent. Foliage aromatic when bruised.

Flowers.—May, with the leaves; monoecious; the staminate in cylindrical, greenish, drooping catkins 3-5 inches long; calyx 6-lobed, borne on a hairy bract; corolla 0; stamens numerous, with purple anthers; the pistillate solitary or several on a common peduncle, about ¼ inch long, their bracts and bractlets hairy; calyx 4-lobed, pubescent; corolla 0; styles and stigmas 2.

Fruit.—October; globose, 1½-2 inches in diameter, smooth, not viscid; solitary or borne in clusters of 2-3; nuts with irregularly furrowed shell, inclosing a sweet, edible kernel; aromatic.

Winter-buds.—Terminal bud ⅓ inch long, ovoid, obliquely blunt, slightly flattened, silky-tomentose.

Bark.—Twigs brownish and hairy, becoming darker and smooth; thick, brownish or blackish on the trunk and deeply furrowed by broad, rounded ridges.

Wood.—Heavy, hard, strong, close-grained, very durable in contact with the soil, rich dark brown, with thin, lighter colored sapwood.

Notes.—The black walnut was once very abundant, especially in the Mississippi basin, where it grew to a height of 150 feet. It is valued for its nuts and beautiful wood. It prefers rich bottom-lands and fertile hillsides. The leaves appear late and fall early. One great drawback to its use in ornamental planting is the fact that it is so often infested with caterpillars.

THE HICKORIES

The hickories are stately trees, quite generally distributed thro out the United States. There are eight species, all peculiar to Am several of which produce edible nuts. Among the latter are the s bark hickory in the north and the pecan in the south.

The flowers, arranged in catkins of the two kinds, appear in spring after the unfolding of the leaves.

The wood of all these trees is heavy, tough and durable. I used for axe handles, agricultural implements, and in places w strength and elasticity are required it is almost unrivaled.

The hickories frequently but erroneously are termed "waln in the popular language of New England. The true walnuts, of w the butternut and black walnut are the American representatives, d from the hickories, although they are closely related.

SUMMER KEY TO THE SPECIES OF CARYA

a. Bark of trunk essentially smooth, not deeply furrowed nor shaggy; husk of fruit less than ⅛ inch thick.

b. Leaflets usually 5-7, glabrous beneath, the upper 2-2½ inches broad; buds dome-shaped, greenish; kernel of nut sweet, **C. glabra,** p. 89.

bb. Leaflets usually 7-11, more or less downy beneath, the upper 1-1½ inches broad; buds long-pointed, flattish, bright yellow; kernel of nut bitter ....**C. cordiformis,** p. 91.

aa. Bark of trunk deeply furrowed or shaggy; husk of fruit more than ⅛ inch thick.

b. Twigs more or less pubescent; bark not shaggy; leaflets 5-7, more or less pubescent beneath; buds densely hairy, **C. alba,** p. 87.

bb. Twigs tending to be glabrous; bark distinctly shaggy; leaflets usually 5, glabrous beneath; buds glabrous or nearly so, **C. ovata,** p. 85.

WINTER KEY TO THE SPECIES OF CARYA

a. Bark of trunk essentially smooth, not deeply furrowed nor shaggy; husk of fruit less than ⅛ inch thick.

b. Terminal bud narrow, long-pointed, flattish, bright yellow, about ¾ inch long; kernel of nut bitter.......**C. cordiformis,** p. 91.

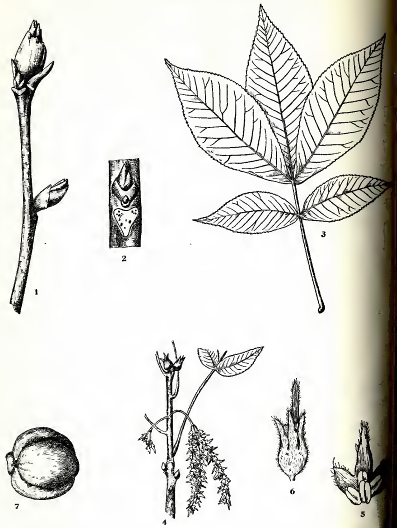
bb. Terminal bud broad, dome-shaped, greenish, ¼-½ inch long; kernel of nut sweet ....**C. glabra,** p. 89.

aa. Bark of trunk deeply furrowed or shaggy; husk of fruit more than ⅛ inch thick.

b. Twigs more or less pubescent; buds densely hairy, the outer bud-scales deciduous in autumn; bark not shaggy..**C. alba,** p. 87.

bb. Twigs tending to be glabrous; buds glabrous or nearly so, the outer bud-scales not deciduous in autumn; bark distinctly shaggy ....**C. ovata,** p. 85.

Shellbark Hickory. Shagbark Hickory



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ⅓.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

JUGLANDACEAE

Shellbark Hickory. Shagbark Hickory

Carya ovata (Mill.) K. Koch [Hicoria ovata (Mill.) Britt.]
[Carya alba Nutt.]

HABIT.—A tree 50-75 feet high, with a slender, columnar trunk 1-2 feet in diameter; forming a narrow, somewhat open crown of stout, slightly spreading limbs and stout branchlets.

LEAVES.—Alternate, compound, 8-14 inches long. Leaflets usually 5, the upper 5-7 inches long and 2-3 inches broad; sessile, except the terminal; obovate to oblong-lanceolate; finely serrate; thick and firm; glabrous, dark green above, paler beneath and glabrous or puberulous. Petioles stout, smooth or hairy. Foliage fragrant when crushed.

FLOWERS.—May-June, after the leaves; monoecious; the staminate hairy, greenish, in pendulous, ternate catkins 4-5 inches long, on a common peduncle about 1 inch long; scales 3-parted, bristle-tipped; stamens 4, with bearded, yellow anthers; the pistillate in 2-5-flowered spikes, ⅓ inch long, brown-tomentose; calyx 4-lobed, hairy; corolla 0; stigmas 2, large, fringed.

FRUIT.—October; globular, 1-2 inches long, with thick husk separating completely; nut usually 4-ridged, with thick shell and large, sweet, edible kernel.

WINTER-BUDS.—Terminal bud ½-¾ inch long, broadly ovoid, obtuse, dark brown, pale-tomentose or nearly glabrous.

BARK.—Twigs brownish, more or less downy, becoming smooth and grayish; thick and grayish on old trunks, separating into thick strips 1-3 feet long, free at one or both ends, giving a characteristic shaggy appearance. Plate II.

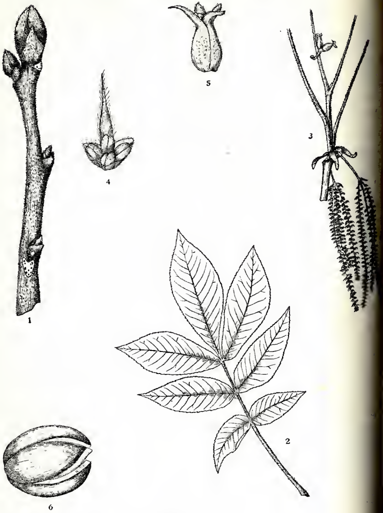
WOOD.—Heavy, very hard and strong, tough, close-grained, elastic, light brown, with thin, whitish sapwood. Page 229.

DISTRIBUTION.—Frequent in the lower altitudes west of the Green mountains; known in the Connecticut valley as far north as Bellows Falls; a large grove on the south side of Bald Mountain in Shrewsbury at an altitude of about 1,500 feet.

HABITAT.—Prefers light, well-drained, loamy soil; low hillsides; river-banks.

NOTES.—The shellbark hickory is one of our most attractive trees. It is known to every boy who lives in its range by its shaggy bark and its excellent nuts.

Mocker Nut. White Heart Hickory



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ⅓.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x ½.

JUGLANDACEAE

Mocker Nut. White Heart Hickory

Carya alba (L.) K. Koch [Hicoria alba (L.) Britt.] [Carya tomentosa Nutt.]

HABIT.—A tree 50-70 feet high, with a trunk diameter of 1-2½ feet; forming a wide crown of strong, upright branches and stout branchlets.

LEAVES.—Alternate, compound, 8-12 inches long. Leaflets usually 5-7, sometimes 9, the upper 5-8 inches long, 3-4 inches broad; sessile, except the terminal; oblong- to obovate-lanceolate; minutely or sometimes coarsely serrate; thick and firm; lustrous, dark yellow-green above, paler and more or less pubescent beneath. Petioles pubescent. Foliage fragrant when crushed.

FLOWERS.—May-June, after the leaves; monoecious; the staminate in pendulous, ternate catkins 4-5 inches long, slender, green, hairy; scales 3-lobed, hairy; stamens 4-5, with red anthers; the pistillate in crowded, 2-5-flowered, tomentose spikes; calyx toothed, hairy; corolla 0; stigmas 2, hairy.

FRUIT.—October; globose to globose-oblong, 1½-2 inches long, with thick husk splitting nearly to the base; nut 4-ridged, red-brown, with very thick, hard shell and small, sweet kernel.

WINTER-BUDS.—Terminal bud ½-¾ inch long, broadly ovoid, red-brown, pilose; outermost scales fall in early autumn.

BARK.—Twigs at first brown-tomentose, becoming smooth and grayish; on the trunk thick, hard, grayish, slightly ridged by shallow, irregular fissures, becoming rugged on very old trunks.

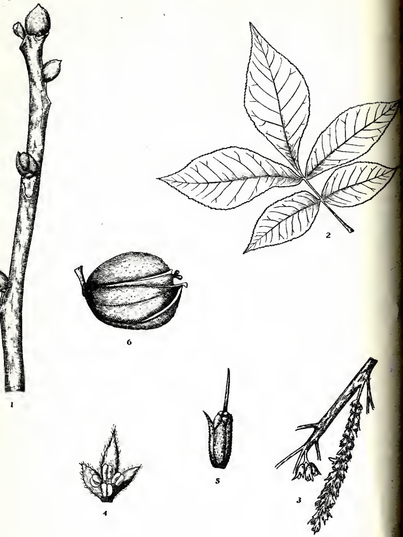
WOOD.—Very heavy, hard, strong, tough, close-grained, elastic, dark brown, with thick, whitish sapwood.

DISTRIBUTION.—Reported from Burlington and West Haven; probably occurs in other localities in the lower altitudes of the southern half of the State.

HABITAT.—Prefers rich, well-drained soil, but grows well in various situations, if they are not too wet.

NOTES.—This tree probably is not distinguished by most observers from *C. ovata*, which it closely resembles; there is need of further and more thorough investigation of this species.

Pignut



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ¼.
3. Flowering branchlet, x 1.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

JUGLANDACEAE

Pignut

Carya glabra (Mill.) Spach. [Hicoria glabra (Mill.) Britt.] [Carya porcina Nutt.]

HABIT.—A tree usually 50-60 feet high, with a trunk diameter of 1-3 feet; forming a low, rather narrow, open crown of slender, often contorted branches.

LEAVES.—Alternate, compound, 8-12 inches long. Leaflets usually 5-7, the upper 3-6 inches long, 2-2½ inches broad; sub-sessile, except the terminal; oblong to obovate-lanceolate, taper-pointed; sharply serrate; thick and firm; glabrous, dark yellow-green above, paler beneath. Petioles long, slender, glabrous or pubescent. Foliage fragrant when crushed.

FLOWERS.—May-June, after the leaves; monoecious; the staminate in pendulous, ternate catkins 3-7 inches long, slender, yellow-green, tomentose; scales 3-lobed, nearly glabrous; stamens 4, with orange anthers; the pistillate in crowded, 2-5-flowered spikes, ¼ inch long; calyx 4-toothed, hairy; corolla 0; stigmas 2, yellow.

FRUIT.—October; variable in size and shape, 1½-2 inches long, with thin husk splitting half-way and sometimes nearly to the base; nut obscurely 4-ridged, with thin or thick, hard shell and small, sweet or slightly bitter kernel which is hard to remove.

WINTER-BUDS.—Terminal bud ¼-½ inch long, dome-shaped, greenish or grayish, smooth or finely downy.

BARK.—Twigs greenish, nearly glabrous, becoming reddish, and finally grayish; thick, hard and grayish on the trunk, with a firm, close surface divided by small fissures and sometimes broken into plates. Plate II.

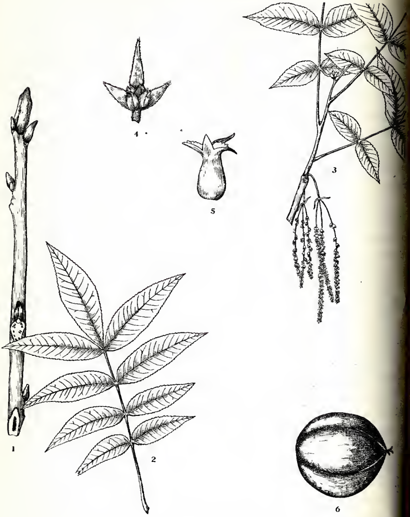
WOOD.—Heavy, hard, very strong, tough, close-grained, elastic, dark brown, with thick, whitish sapwood.

DISTRIBUTION.—Occurs in the southern portion of Vermont.

HABITAT.—Prefers deep, rich loam, but grows in any well-drained soil; dry ridges and hillsides.

NOTES.—This is a common tree in the Hoosic valley, Pownal, and a large grove occurs on the shore of Lake Bomoseen, West Castleton (Eggleston). There are a few trees near the Hubbardton line in East Castleton (G. H. Ross). In the Connecticut valley it is abundant on the hills near the river in the vicinity of the Massachusetts line, but is not common above Bellows Falls (Flint). Observers of trees in southern Vermont should strive further to increase our knowledge of its distribution.

Bitternut Hickory



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ⅓.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

JUGLANDACEAE

Bitternut Hickory

Carya cordiformis (Wang.) K. Koch [Hicoria minima (Marsh.) Britt.] [Carya amara Nutt.]

HABIT.—A tall, slender tree 50-75 feet high, with a trunk diameter of 1-2½ feet; forming a broad crown of slender, stiff, upright branches, widest near the top.

LEAVES.—Alternate, compound, 6-10 inches long. Leaflets 5-11, the upper 4-6 inches long and one-fourth as broad; sessile, except the terminal; lanceolate to oblong-lanceolate, long-pointed; coarsely serrate; thin and firm; glabrous, bright green above, paler and more or less downy beneath. Petioles slender, hairy. Foliage fragrant when crushed.

FLOWERS.—May-June, after the leaves; monoecious; the staminate slightly pubescent, in pendulous, ternate catkins 3-4 inches long, on a common peduncle about 1 inch long; scale 3-lobed, hairy; stamens 4, with bearded, yellow anthers; the pistillate in 2-5-flowered spikes, ½ inch long, scurfy-tomentose; calyx 4-lobed, pubescent; corolla 0; stigmas 2, greenish.

FRUIT.—October; obovate to globular, about 1 inch long, coated with yellow, scurfy pubescence, with very thin husk splitting half-way to the base, with sutures winged at the top; nut quite smooth, with thin shell and small, bitter kernel.

WINTER-BUDS.—Terminal bud about ¾ inch long, long-pointed, flattish, granular-yellow; lateral buds more or less 4-angled.

BARK.—Twigs greenish and more or less downy, becoming brownish, and finally grayish; gray, close, smooth on the trunk, often reticulately ridged, but rarely broken into plates. Plate III.

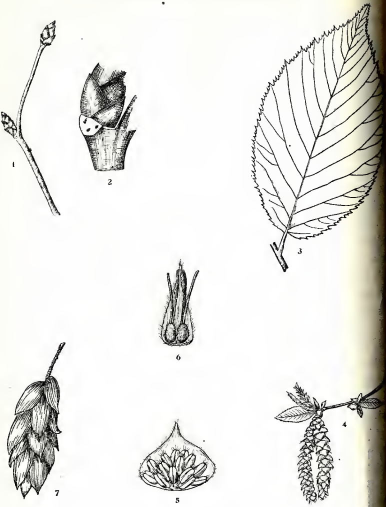
WOOD.—Heavy, very hard, strong, tough, close-grained, dark brown, with thick, lighter colored sapwood.

DISTRIBUTION.—Frequent in the lower altitudes west of the Green mountains and known in the Connecticut valley as far north as Hartland.

HABITAT.—Prefers a rich, loamy soil; low, wet woods; along the borders of streams.

NOTES.—The bitternut grows most rapidly of all the hickories, but it is apt to show dead branches. It should be propagated from the seed, as it is not easily transplanted. The yellow buds at once distinguish it from all other hickories.

American Hop Hornbeam. Leverwood



(Mich. Trees).

1. Winter twig, x ½.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

BETULACEAE

American Hop Hornbeam. Leverwood

Ostrya virginiana (Mill.) K. Koch

HABIT.—A small tree usually 20-30 feet high, with a trunk diameter of 8-12 inches; forming a broad, rounded crown of many long, slender branches and a slender, stiff spray.

LEAVES.—Alternate, simple, 3-5 inches long, about one-half as broad; oblong-ovate; sharply doubly serrate; thin and very tough; dull, dark green above, paler and more or less pubescent beneath; petioles short, slender, pubescent.

FLOWERS.—May, with the leaves; monoecious; the staminate in drooping, cylindrical catkins from wood of the previous season, usually in threes; stamens 3-14, crowded on a hairy torus; the pistillate in erect, lax catkins on the season's shoots, usually in pairs, each flower inclosed in a hairy, sac-like involucre.

FRUIT.—September; strobiles, resembling clusters of hops, 1-2 inches long, borne on slender, hairy stems; nuts small and flat, inclosed by sac-like involucres.

WINTER-BUDS.—Terminal but absent; lateral buds ⅛-¼ inch long, ovoid, acute, red-brown.

BARK.—Twigs at first light green, becoming lustrous, red-brown, and finally dull dark brown; thin, gray-brown on the trunk, very narrowly and longitudinally ridged. Plate III.

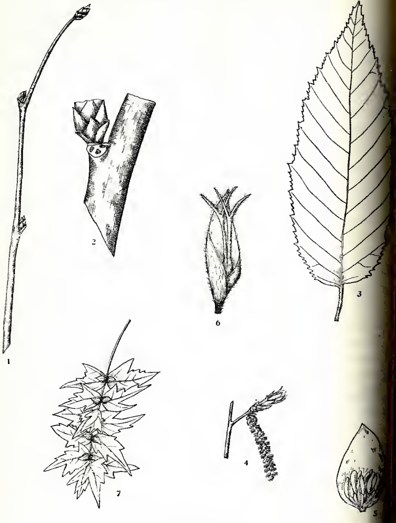
WOOD.—Heavy, very strong and hard, tough, close-grained, durable, light red-brown, with thick, whitish sapwood.

DISTRIBUTION.—Common to both valleys and mountains of Vermont, but more abundant in the western and southern portions.

HABITAT.—Rich woods; open woods; slopes and ridges.

NOTES.—Hornbeams sometimes are mistaken and transplanted for elms, owing to the general similarity in the appearances of the young trees. The leaves of the hornbeam, however, are nearly symmetrical at the base, while those of the elm are more unequally developed. In late summer the hornbeam is easily distinguished by its fruit hanging in hop-like heads. The hornbeam is distributed, quite generally, both in the valleys and the mountainous parts of Vermont, but is most common in western and southern portions. It is a small tree. The wood is very strong, tough and durable in contact with the soil, hence the names ironwood, leverwood. It is used for levers, mallets and for fencing materials.

American Hornbeam. Blue Beech. Water Beech



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x ½.

BETULACEAE

American Hornbeam. Blue Beech. Water Beech

Carpinus caroliniana Walt.

HABIT.—Usually a low, bushy tree or large shrub, 10-30 feet high, with a trunk diameter of 6-12 inches; trunk short, usually fluted; slender zigzag branches and a fine spray form a close, flat-topped crown.

LEAVES.—Alternate, simple, 2-4 inches long and one-half as broad; ovate to oval, long-pointed; sharply doubly serrate; thin and firm; dull green above, lighter beneath, turning scarlet and orange in autumn; petioles short, slender, hairy.

FLOWERS.—May, after the leaves; monoecious; apetalous; the staminate catkins 1-1½ inches long, their scales greenish, boat-shaped, each bearing 3-20 stamens; the pistillate catkins ½-¾ inch long, their scales hairy, greenish, each bearing 2 pistils with long, scarlet styles.

FRUIT.—Ripens in midsummer, but often remains on the tree long after the leaves have fallen; in loose, terminal strobiles; involucre halberd-shaped, inclosing a small, ovate, brownish nut.

WINTER-BUDS.—Terminal bud absent; lateral buds ⅛ inch long, narrow-ovoid, acute, puberulous, brownish.

BARK.—Twigs pale green, hairy, becoming lustrous, dark red the first winter; trunk and large limbs thin, smooth, close, dark bluish gray, often mottled with lighter or darker patches.

WOOD.—Heavy, hard, tough, very strong, close-grained, light brown, with thick, whitish sapwood.

DISTRIBUTION.—Frequent throughout Vermont at the lower altitudes.

HABITAT.—Deep, rich, moist soil along the borders of streams and swamps. Often found in drier situations in the shade of other trees.

NOTES.—The blue beech is a small, bushy tree rarely over twenty feet high. It is not uncommon in moist soil along streams, but does not reach the higher altitudes. It is distinguished in spring by its tiny flowers arranged in loose catkins and in July by the curious leaf-like wings which develop upon the fruit. A glance at its trunk makes its recognition certain at any time of year. It has a close, gray bark resembling that of the beech but with furrows and ridges suggesting the muscles of a strong man's arm. It is the toughest of all our woods.

THE BIRCHES

The birches are distributed widely over the Old and the Ne Worlds, being most abundant in the higher latitudes. Nine spec occur in North America, four of which are found in Vermont. The are all graceful trees with slender flexuous branches and delicate foliage. Both the ovule-bearing and pollen-bearing flowers are found o the same tree, but in separate clusters. The staminate catkins are lo and drooping, while the pistillate are shorter and not pendulous unti fruited.

The wood of birches is valued chiefly for cabinet making, spoo and other small articles.

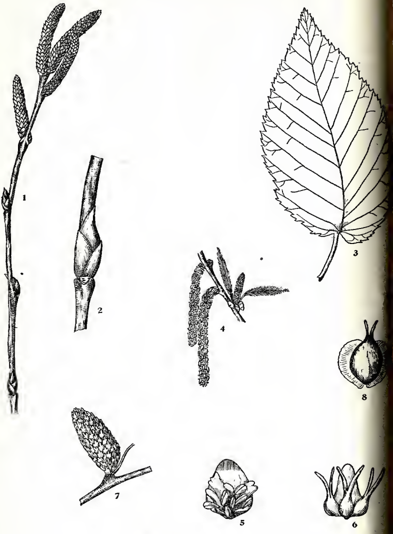
SUMMER KEY TO THE SPECIES OF BETULA

a. Bark of trunk chalky-white; twigs without wintergreen taste.
  b. Twigs usually warty-glandular; bark of trunk not separating freely into thin, papery layers; inner bark dingy yellow; leaves nearly triangular to rhombic-ovate, long-pointed; small tree, with trunk 6-10 inches in diameter..... **B. populifolia,** p. 103.
  bb. Twigs not warty-glandular; bark of trunk separating freely into thin, papery layers, exposing the bright cinnamon-yellow inner bark; leaves ovate, not long-pointed; large tree, with trunk 1-3 feet in diameter .... **B. alba papyrifera,** p. 105.
aa. Bark of trunk not chalky-white, usually dark colored; twigs with more or less wintergreen taste.
  b. Bark dirty yellow, breaking into strips more or less curled at the edges; leaves solitary or in pairs, slightly aromatic; twigs with slight wintergreen taste .... **B. lutea,** p. 101.
  bb. Bark dark red-brown, cleaving off in thick, irregular plates (resembles bark of black cherry); leaves in pairs, strongly aromatic; twigs with strong wintergreen taste.......... **B. lenta,** p. 99.

WINTER KEY TO THE SPECIES OF BETULA

a. Bark of trunk chalky-white; twigs without wintergreen taste.
  b. Twigs usually warty-glandular; bark of trunk not separating freely into thin, papery layers; inner bark dingy yellow; small tree, with trunk 6-10 inches in diameter... **B. populifolia,** p. 103.
  bb. Twigs not warty-glandular; bark of trunk separating into thin, papery layers, exposing the bright cinnamon-yellow inner bark; large tree, with trunk 1-3 feet in diameter,
B. alba papyrifera, p. 105.
aa. Bark of trunk not chalky-white, usually dark colored; twigs with more or less wintergreen taste.
  b. Bark dirty yellow, breaking into strips more or less curled at the edges; twigs with slight wintergreen taste... **B. lutea,** p. 101.
  bb. Bark dark red-brown, cleaving off in thick, irregular plates (resembles bark of black cherry); twigs with strong wintergreen taste .... **B. lenta,** p. 99.

Cherry Birch. Sweet Birch. Black Birch



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruiting branchlet, x ½.
8. Fruit, enlarged.

BETULACEAE

Cherry Birch. Sweet Birch. Black Birch

Betula lenta L.

HABIT.—A medium-sized tree 50-75 feet high, with a trunk diameter of 1-3 feet; slender, wide-spreading, pendulous branches, forming a narrow, rounded, open crown.

LEAVES.—Alternate in pairs, simple, 3-4 inches long and one-half as broad; outline variable, ovate to oblong-ovate; sharply doubly serrate, with slender, incurved teeth; dull, dark green above, light yellow-green beneath; petioles short, stout, hairy, deeply grooved above; aromatic.

FLOWERS.—April-May, before the leaves; monoecious; the staminate catkins 3-4 inches long, slender, pendent, yellowish; the pistillate catkins ½-¾ inch long, erect or suberect, greenish.

FRUIT.—Ripens in autumn; sessile, glabrous, erect strobiles, 1-1½ inches long and half as thick; scales glabrous; nuts slightly broader than their wings.

WINTER-BUDS.—Terminal bud absent; lateral buds about ¼ inch long, conical, sharp-pointed, red-brown, divergent.

BARK.—Twigs light green, becoming lustrous, red-brown in their first winter; very dark on old trunks, cleaving off in thick, irregular plates. Resembles bark of black cherry. Inner bark aromatic, spicy.

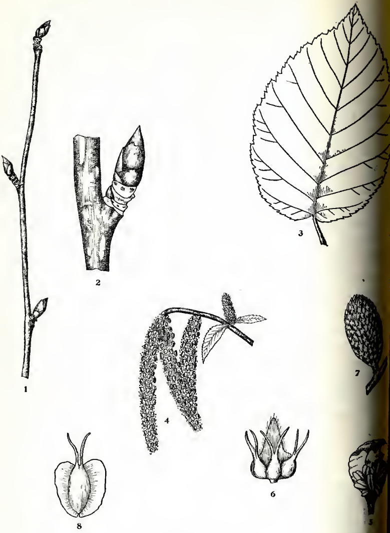
WOOD.—Heavy, very hard and strong, close-grained, dark red-brown, with thin, lighter colored sapwood.

DISTRIBUTION.—Frequent in western Vermont to the foot-hills of the Green mountains and known in the Connecticut valley as far north as Hartford.

HABITAT.—Rich woodlands of the lower altitudes.

NOTES.—The distinctive characters of this tree are well known to many Vermonters, who, as children, have become familiar with the sweet wintergreen flavor of bark and leaves. It is common in western Vermont, but reaches only the foothills of the Green mountains. Its northern limit in the Connecticut valley is in the vicinity of Norwich. Two kinds of catkins are noticeable upon the bare trees in winter; and they open on the first spring days, before most other trees have made a visible response to the sun's rays. The wood is valuable for furniture and fuel.

Yellow Birch. Gray Birch



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruiting branchlet, x ½.
8. Fruit, x 10.

BETULACEAE

Yellow Birch. Gray Birch

Betula lutea Michx. f.

Habit.—A tree 60-80 feet high and 2-4 feet in trunk diameter; numerous slender, pendulous branches form a broad, open, rounded crown.

Leaves.—Alternate, solitary or in pairs, simple, 3-5 inches long and one-half as broad; ovate to oblong-ovate; sharply doubly serrate; dull dark green above, yellow-green beneath; petioles short, slender, grooved, hairy; slightly aromatic.

Flowers.—April-May, before the leaves; monoecious; the staminate catkins 3-4 inches long, slender, pendent, purplish yellow; the pistillate catkins sessile or nearly so, erect, almost 1 inch long, greenish.

Fruit.—Ripens in autumn; sessile or short-stalked, erect, glabrous strobiles, about 1 inch long and half as thick; scales downy on the back and edges; nut about as broad as the wing.

Winter-buds.—Terminal bud absent; lateral buds about ¼ inch long, conical, acute, chestnut-brown, more or less appressed; bud-scales more or less pubescent.

Bark.—Twigs, branches and young stems smooth, very lustrous, silvery gray or light orange; becoming silvery yellow-gray as the trunk expands and breaking into strips more or less curled at the edges; old trunks becoming gray or blackish, dull, deeply and irregularly fissured into large, thin plates; somewhat aromatic, slightly bitter. Plate III.

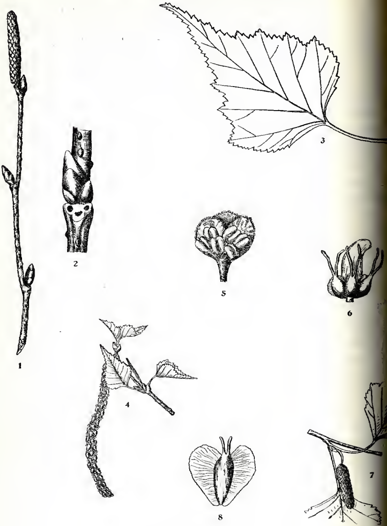
Wood.—Heavy, very strong and hard, close-grained, light brown tinged with red, with thin, whitish sapwood. Page 227.

Distribution.—Frequent throughout Vermont, especially on the mountain slopes up to 1,000 feet altitude.

Habitat.—Rich, cool soils; mountain slopes; borders of swamps.

Notes.—The polished silvery yellow bark of the mature tree marks the yellow birch almost as clearly as does the red-brown bark in the case of the preceding species. On the oldest trees in the primeval forest, however, the bark becomes a darker bronze and rough. It is common in nearly all parts of Vermont, but especially in rich, cool soils, and it extends far up the sides of our higher mountains. During the winter the little catkins remain tightly closed, but by May they lengthen into slender, drooping catkins. Yellow birch lumber is valuable for many purposes. It takes a beautiful polish, and is becoming increasingly popular for furniture and for flooring. Because of its graceful form and attractive, yellow bark, it merits more general usage for ornamental planting.

White Birch. Gray Birch. Old Field Birch



1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruiting branchlet, x ½.
8. Fruit, enlarged.

BETULACEAE

White Birch. Gray Birch. Old Field Birch.

Betula populifolia Marsh.

HABIT.—A small tree 20-30 feet high, with a slender, usually leaning trunk 6-10 inches in diameter; slender, somewhat contorted branches clothe the trunk to the ground, forming a narrow-pyramidal, open, pointed crown; commonly growing in clusters of several trunks.

LEAVES.—Alternate, solitary or in pairs, simple, 2-3 inches long and two-thirds as broad; nearly triangular to rhombic-ovate, long-pointed; coarsely doubly serrate; lustrous, dark green above, paler beneath; petioles long, slender, covered with black glands. Tremulous with the slightest breeze.

FLOWERS.—April-May, with the leaves; monoecious; the staminate catkins usually solitary, 2-4 inches long, slender, pendent, yellowish; the pistillate catkins ½-1 inch long, erect or suberect, greenish, on peduncles ½ inch long.

FRUIT.—Ripens in autumn; slender-stalked, pubescent, erect or drooping strobiles, about 1 inch long and one-third as thick; scales finely hairy; nuts slightly narrower than their wings.

WINTER-BUDS.—Terminal bud absent; lateral buds ⅛-¼ inch long, ovoid, acute, pale brown, divergent.

BARK.—Twigs green and warty-glandular, becoming smooth and red-brown; bark of trunk close, not peeling, dull chalky-white on the outer surface, with dark, triangular patches below the insertion of branches, reddish yellow on the inner, becoming nearly black and shallowly fissured at the base of old trunks.

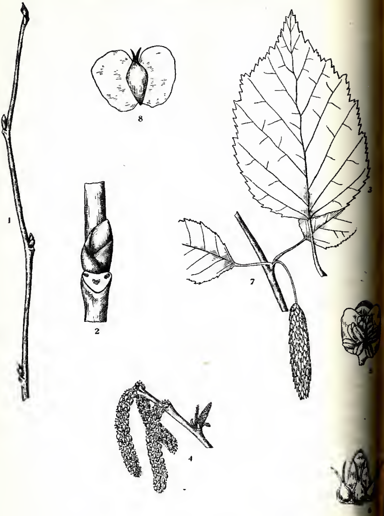
WOOD.—Light, soft, weak, close-grained, light brown, with thick, whitish sapwood.

DISTRIBUTION.—Common in the Champlain valley; frequent in the southern portion of Vermont.

HABITAT.—Poor, sandy soil; old fields; waste lands.

NOTES.—The white birch at best is but a small, short-lived tree, but it grows in such numbers that it is sure to attract attention. It never reaches sufficient size to become a valuable lumber tree, but its light elastic stem always is in demand for spools, shoe-pegs, and barrel-hoops. The white birch with its white trunk and graceful branches and light, delicate foliage is one of our most beautiful trees, but its desirability for transplanting is lessened by its short life and liability to injury from storms.

Paper Birch. Canoe Birch. White Birch



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruiting branchlet, x ½.
8. Fruit, x 3½.

BETULACEAE

Paper Birch. Canoe Birch. White Birch

Betula alba papyrifera (Marsh.) Spach. [Betula papyrifera Marsh.]

HABIT.—A tree 50-75 feet high, with a trunk diameter of 1-3 feet, forming in youth a compact, pyramidal crown of many slender branches, becoming in old age a long, branchless trunk with a broad, open crown, composed of a few large limbs ascending at an acute angle, with almost horizontal branches and a slender, flexible spray.

LEAVES.—Alternate, simple, 2-3 inches long, 1½-2 inches broad; ovate; coarsely, more or less doubly serrate; thick and firm; glabrous, dark green above, lighter beneath, covered with minute black glands; petioles stout, yellow, glandular, glabrous or pubescent.

FLOWERS.—April-May, before the leaves; monoecious; the staminate catkins clustered or in pairs, 3-4 inches long, slender, pendent, brownish; the pistillate catkins about 1½ inches long, slender, erect or spreading, greenish; styles bright red.

FRUIT.—Ripens in autumn; long-stalked, cylindrical, glabrous, drooping strobiles, about 1½ inches long; scales hairy on the margin; nut narrower than its wing.

WINTER-BUDS.—Terminal bud absent; lateral buds ¼ inch long, narrow-ovoid, acute, flattish, slightly resinous, usually divergent.

BARK.—Twigs dull red, becoming lustrous, orange-brown; bark of trunk and large limbs cream-white and lustrous on the outer surface, bright orange on the inner, separating freely into thin, papery layers, becoming furrowed and almost black near the ground. Plate III.

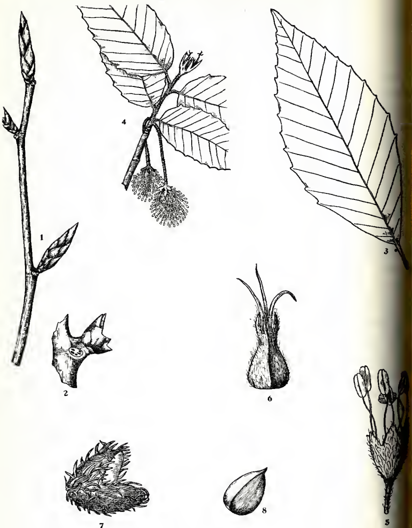
WOOD.—Light, hard, strong, tough, very close-grained, light brown tinged with red, with thick, whitish sapwood.

DISTRIBUTION.—Common throughout Vermont.

HABITAT.—Prefers rich, moist hillsides; borders of streams, lakes and swamps; mountain slopes.

NOTES.—The paper birch is often intermingled with the white birch and is confused popularly with it, although careful observation reveals many characteristics by which the two may be distinguished. The paper birch is a larger tree than the white birch and more widely distributed. The two species are similar in the chalky whiteness of the bark, but that of the white birch clings closely so that it cannot be separated in large layers, whereas the peculiar character of the paper birch is the ease with which ample sheets of the beautiful corky layers may be removed.

Beech



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Flowering branchlet, x ¾.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Bur, opened, x 1.
8. Nut, x 1.

FAGACEAE

Beech

Fagus grandifolia Ehrh. [Fagus atropunicea (Marsh.) Sudw.] [Fagus ferruginea Ait.] [Fagus americana Sweet]

HABIT.—A beautiful tree, rising commonly to a height of 50-75 feet, with a trunk diameter of 2-4 feet; in the forest, tall and slender, with short branches forming a narrow crown, in the open with a short, thick trunk and numerous slender, spreading branches, forming a broad, compact, rounded crown.

LEAVES.—Alternate, simple, 3-5 inches long, one-half as broad; oblong-ovate, acuminate; coarsely serrate, a vein terminating in each tooth; thin; dark blue-green above, light yellow-green and very lustrous beneath; petioles short, hairy.

FLOWERS.—May, with the leaves; monoecious; the staminate in globose heads 1 inch in diameter, on long, slender, hairy peduncles, yellow-green; calyx campanulate, 4-7-lobed, hairy; corolla 0; stamens 8-10; the pistillate on short, hairy peduncles in 2-flowered clusters surrounded by numerous awl-shaped, hairy bracts; calyx urn-shaped, 4-5-lobed; corolla 0; ovary 3-celled; styles 3.

FRUIT.—Ripens in autumn; a prickly bur borne on stout, hairy peduncles, persistent on the branch after the nuts have fallen; nuts usually 3, ¾ inch long, sharply tetrahedral, brownish; sweet and edible.

WINTER-BUDS.—Nearly 1 inch long, very slender, cylindrical, gradually taper-pointed, brownish, puberulous.

BARK.—Twigs lustrous, olive-green, finally changing through brown to ashy gray; close, smooth, steel-gray on the trunk, often mottled by darker blotches and bands. Plate IV.

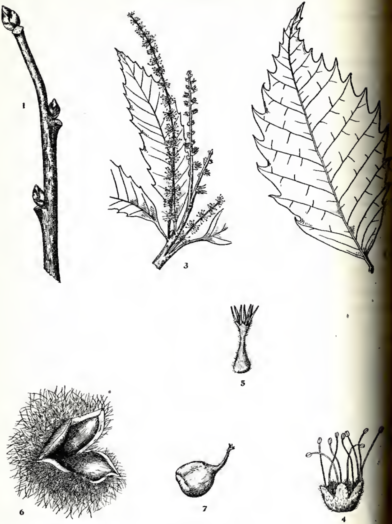
WOOD.—Hard, tough, strong, very close-grained, not durable, difficult to season, light or dark red, with thin, whitish sapwood. Page 227.

DISTRIBUTION.—Abundant throughout Vermont.

HABITAT.—Rich uplands; moist, rocky soil.

NOTES.—The beech, when growing in the forest, with its tall, graceful trunk, its smooth, gray bark and shiny leaves, is a handsome tree. It is not only one of the most common trees in Vermont, but also one of the most widely distributed in eastern North America. The drooping clusters of pollen-bearing flowers and the short, stout ovule-bearing heads open under the newly spreading leaves in early May. The burs open and the nuts fall with the first frosts of autumn.

Chestnut



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Prickly bur, opened, x ½.
7. Nut, x ½.

FAGACEAE

Chestnut

Castanea dentata (Marsh.) Borkh. [Castanea vesca, v. americana Michx.] [Castanea sativa, v. americana Sarg.]

HABIT.—A tree 60-80 feet high, forming a short, straight trunk 2-4 feet in diameter, divided not far above the ground into several stout, horizontal limbs and forming a broad, open, rounded crown.

LEAVES.—Alternate, simple, 6-8 inches long, 2-3 inches broad; oblong-lanceolate, long-pointed at the apex; coarsely serrate with stout, incurved, glandular teeth; thin; dull yellow-green above, lighter beneath, glabrous; petioles short, stout, puberulous.

FLOWERS.—July, after the leaves; monoecious; the staminate catkins 6-8 inches long, slender, puberulous, bearing 3-7-flowered cymes of yellow-green flowers; calyx 6-cleft, pubescent; stamens 10-20; the androgynous catkins 2½-5 inches long, puberulous, bearing 2-3 prickly involucres of pistillate flowers near their base; calyx campanulate, 6-lobed; styles 6.

FRUIT.—Ripens in autumn; round, thick, prickly burs, about 2 inches in diameter, containing 1-3 nuts; nuts compressed, brownish, coated with whitish down at the apex; sweet and edible.

WINTER-BUDS.—Terminal bud absent; lateral buds ¼ inch long, ovoid, acute, brownish.

BARK.—Twigs lustrous, yellow-green, becoming olive-green and finally dark brown; old trunks gray-brown, with shallow fissures and broad, flat ridges. Plate IV.

WOOD.—Light, soft, coarse-grained, weak, easily split, very durable in contact with the soil, red-brown, with very thin, lighter colored sapwood.

DISTRIBUTION.—Frequent in the Connecticut valley as far north as Bellows Falls and in southwestern Vermont; occasional as far north as Windsor, West Rutland, Leicester, Burlington, Colchester and Stowe. Planted as far north as Franklin.

HABITAT.—Rocky woods and hillsides.

NOTES.—The chestnut probably will grow in all parts of Vermont. It is a rapid grower and lives to a great age but is subject to a disease which threatens extermination in this country. The leaves are shiny and graceful, from six to eight inches long. When they are nearly grown, long, stiff catkins of fragrant, greenish-yellow flowers appear. These bear the pollen, the ovule-bearing flowers being smaller, enclosed in bur-like scales. The nuts, two or three in a bur, ripen in October.

THE OAKS

The oaks, abundant throughout the northern hemisphere, are remarkable for their massive trunks, their thick, rugged bark and large, strong roots. They are distinguished from all other trees by their cupped fruit, but many who have seen these fruits have not noticed the small, scaly masses of flowers which produce them. The pollen-bearing flowers are found on the same tree, but are arranged in long, slender catkins consisting of a cluster of from three to twelve stamens. Some of the oaks, including the red and black, do not mature their fruit until the second year.

Oak timber is of great commercial value, being used for a variety of purposes. For strength, toughness and durability combined, it is unsurpassed.

The oak genus is a large one. Nine species and two hybrids are included in the last flora of Vermont. They are extremely difficult to tell apart and the late Doctor Pringle remarked that after 25 years of study he did not know the oaks of Vermont. This genus varies greatly and some valuable work could be done in studying its variations.

Only the tree oaks are given in the following keys.

SUMMER KEY TO THE SPECIES OF QUERCUS

a. Leaves deeply cut or lobed.

- *b.* Leaf-lobes acute, bristle-tipped; fruit maturing in the seco season.
  - *c.* Lower surface of leaves more or less pubescent; buds hoar tomentose; bark of trunk deeply furrowed and scaly; inn bark yellow; nut ½-¾ inch long, inclosed for about one-ha of its length by a deep, turbinate cup.... **Q. velutina,** p. 12
  - *cc.* Lower surface of leaves glabrous or nearly so; buds glabrou bark of trunk smoothish or only slightly fissured; inner bar whitish or pinkish; nut about 1 inch long, inclosed only the base by a shallow, saucer-shaped cup.. **Q. rubra,** p. 12
- *bb.* Leaf-lobes rounded, not bristle-tipped; fruit maturing in t first season.
  - *c.* Leaves cut nearly to the midrib by a pair of deep sinuses nea the middle of the leaf; branches corky-ridged; nut usual ¾-1½ inches long, deeply seated in a large, conspicuous fringed cup .... **Q. macrocarpa,** p. 11
  - *cc.* Leaves not cut by a pair of deep sinuses; branches not cork ridged; nut about ¾ inch long, about one-fourth inclosed a thin, tomentose, warty cup.............. **Q. alba,** p. 11

aa. Leaves not deeply cut nor lobed.

- *b.* Bark on branches breaking into large, papery scales which cu back; acorns on stems 1-4 inches long; tree typical of swamps. **Q. bicolor,** p. 11
- *bb.* Bark on branches close, not breaking into large, papery scale acorns sessile or on stalks less than 1 inch long; trees not typic of swamps.
  - *c.* Bark of trunk thin, not deeply fissured into inverted V-shape ridges, flaky, silvery gray or ash colored; leaves coarse toothed .... **Q. muhlenbergii,** p. 12
  - *cc.* Bark of trunk thick, deeply fissured into inverted V-shape ridges, not flaky, dark red-brown to nearly black; leav coarsely crenate .... **Q. prinus,** p. 12

WINTER KEY TO THE SPECIES OF QUERCUS

a. Terminal buds usually about ⅛ inch long.

b. Twigs thick-tomentose; entire bud pale-pubescent; branches corky-ridged; cup of acorn conspicuously fringed at the rim,
[1][1] **Q. macrocarpa,** p. 117.

bb. Twigs glabrous; buds glabrous, or only slightly or partially pubescent; branches without corky ridges; cup of acorn not conspicuously fringed at the rim.

c. Bark on branches breaking into large, papery scales which curl back; buds pilose above the middle; acorns on stems 1-4 inches long .... [1] **Q. bicolor,** p. 119.

cc. Bark on branches not breaking into large, papery scales; buds glabrous; acorns sessile or very short-stalked.

d. Buds conical, acute; bud-scales scarious on the margins; nut white-downy at the apex.... [1] **Q. muhlenbergii,** p. 121.

dd. Buds broadly ovoid, obtuse; bud-scales not scarious on the margins; nut not white-downy at the apex,
[1] **Q. alba,** p. 115.

aa. Terminal buds usually about ¼ inch long.

b. Buds strictly glabrous throughout; bark of trunk smoothish or only slightly fissured, inner bark not bitter-tasting; nut inclosed only at the base by a shallow, saucer-shaped cup,
[2][2] **Q. rubra,** p. 125.

bb. Buds more or less pubescent or tomentose; bark of trunk deeply furrowed and roughish, inner bark bitter-tasting; nut inclosed for about one-half of its length by a deep, cup-shaped or turbinate cup.

c. Buds hoary-tomentose, obtuse at the apex, strongly angled; inner bark of trunk yellow; acorns maturing in autumn of second season; nut ½-¾ inch long, with bitter kernel,
[2] **Q. velutina,** p. 127.

cc. Buds slightly hairy, sharp-pointed, not strongly angled; inner bark of trunk not yellow; acorns maturing in autumn of first season; nut 1-1½ inches long, with sweet kernel,
[1] **Q. prinus,** p. 123.

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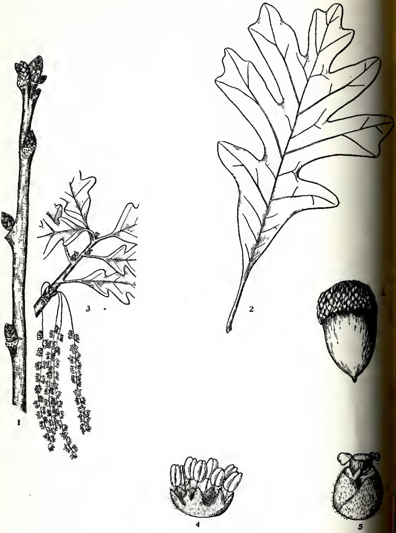
[1] [1] means that the acorns mature in the autumn of the first season, hence mature acorns will not be found on the tree, but on the ground beneath the tree.

[2] [2] means that the acorns mature in the autumn of the second season, hence immature acorns will be found on the last season's twigs, and mature acorns on the ground beneath the tree.

White Oak



(Mich. Trees).

1. Winter twig, x 1½.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

FAGACEAE

White Oak

Quercus alba L.

HABIT.—A large tree 50-75 feet high, with a trunk diameter of 2-4 feet; forming a short, thick trunk with stout, horizontal, far-reaching limbs, more or less gnarled and twisted in old age, and a broad, open crown.

LEAVES.—Alternate, simple, 5-9 inches long, about one-half as broad; obovate to oblong; 5-9-lobed, some with broad lobes and shallow sinuses, others with narrow lobes and deep, narrow sinuses, the lobes usually entire; thin and firm; glabrous, bright green above, pale or glaucous beneath; often persistent on the tree through the winter.

FLOWERS.—May, with the leaves; monoecious; the staminate in hairy catkins 2-3 inches long; the pistillate sessile or short-peduncled, reddish, tomentose; calyx campanulate, 6-8-lobed, yellow, hairy; corolla 0; stamens 6-8, with yellow anthers; stigmas red.

FRUIT.—Autumn of first season; sessile or short-stalked acorns; cup with small, brown-tomentose scales, inclosing one-fourth of the nut; nut oblong-ovoid, rounded at the apex, about ¾ inch long, light brown; kernel sweet and edible.

WINTER-BUDS.—Terminal bud ⅛ inch long, broadly ovoid, obtuse; scales smooth, dark red-brown.

BARK.—Twigs at first bright green, tomentose, later reddish, and finally ashy gray; thick, light gray or whitish on old trunks, shallowly fissured into broad, flat ridges. Plate IV.

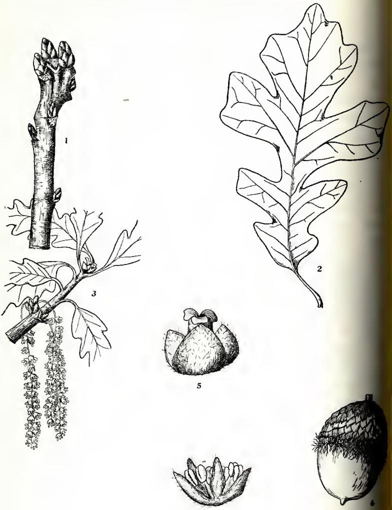
WOOD.—Very heavy, strong, hard, tough, close-grained, durable, light brown, with thin, light brown sapwood.

DISTRIBUTION.—Common west of the Green mountains; occurs sparingly in the Connecticut valley as far north as Wells River.

HABITAT.—Grows well in all but very wet soils, in all open exposures; dry woods.

NOTES.—The white oak is the most beautiful as well as the most useful of the oaks found in this part of the United States. Vermont has quite a generous supply of these trees in the Champlain valley. The tough, heavy wood of the white oak needs no recommendation. On account of the beauty of its grain and its capability of taking a high polish, it is used extensively for furniture and for interior finishing. The famous "Charter Oak" of Connecticut was of this species.

Bur Oak. Over-cup Oak. Mossy-cup Oak



(Mich. Trees).

1. Winter twig, x 2.
2. Leaf, x ⅓.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate, enlarged.
6. Fruit, x 1.

FAGACEAE

Bur Oak. Over-cup Oak. Mossy-cup Oak

Quercus macrocarpa Michx.

HABIT.—A medium-sized tree 40-60 feet high, with a trunk 2-4 feet in diameter; great, spreading branches form a broad, rugged crown.

LEAVES.—Alternate, simple, 6-10 inches long and one-half as broad; obovate to oblong, wedge-shaped at the base; crenately lobed, usually cut nearly to the midrib by two opposite sinuses near the middle; thick and firm; dark green and shining above, pale pubescent beneath; petioles short, stout.

FLOWERS.—May, with the leaves; monoecious; the staminate in slender, hairy catkins 4-6 inches long; the pistillate sessile or short-stalked, reddish, tomentose; calyx 4-6-lobed, yellow-green, downy; corolla 0; stamens 4-6, with yellow anthers; stigmas bright red.

FRUIT.—Autumn of first season; sessile or short-stalked acorns; very variable in size and shape; cup typically deep, cup-shaped, tomentose, fringed at the rim, inclosing one-third or all of the nut; nut broad-ovoid, ½-1½ inches long, brownish, pubescent; kernel white, sweet and edible.

WINTER-BUDS.—Terminal bud ⅛ inch long, broadly ovoid or conical, red-brown, pale-pubescent.

BARK.—Twigs yellow-brown, thick-tomentose, becoming ash-gray or brownish; branches with corky ridges; thick and gray-brown on the trunk, deeply furrowed.

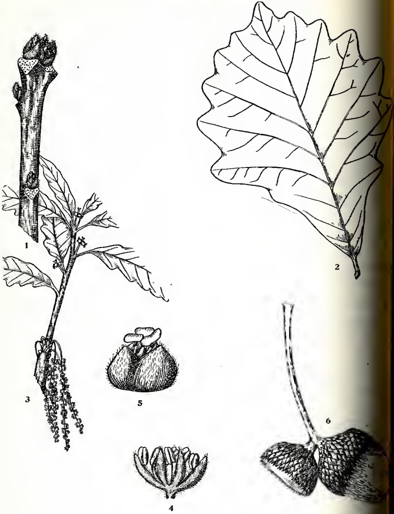
WOOD.—Heavy, hard, strong, tough, close-grained, very durable, brownish, with thin, pale sapwood.

DISTRIBUTION.—Occasional in the Champlain valley, more common in Addison county.

HABITAT.—Prefers rich, moist soil; bottom-lands.

NOTES.—The bur oak is easily recognized by its mossy cups. It is occasionally planted as an ornamental tree, but on account of its large size it is suitable only for parks and large estates. Commercially its wood is not distinguished from the white oak.

Swamp White Oak



(Mich. Trees).

1. Winter twig, x 2.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

FAGACEAE

Swamp White Oak

Quercus bicolor Willd. [Quercus platanoides (Lam.) Sudw.]

HABIT.—A medium-sized tree 40-60 feet high, with a trunk diameter of 2-3 feet; forming a rather open, rugged crown of tortuous, pendulous branches and short, stiff, bushy spray.

LEAVES.—Alternate, simple, 5-7 inches long, 3-5 inches broad; obovate to oblong-obovate; coarsely sinuate-crenate or shallow-lobed; thick and firm; dark green and shining above, whitish and more or less tomentose beneath; petioles stout, about ½ inch long.

FLOWERS.—May, with the leaves; monoecious; the staminate in hairy catkins 3-4 inches long; the pistillate tomentose, on long, tomentose peduncles, in few-flowered spikes; calyx deeply 5-9-lobed, yellow-green, hairy; corolla 0; stamens 5-8, with yellow anthers; stigmas bright red.

FRUIT.—Autumn of first season; acorns on pubescent stems 1-4 inches long, usually in pairs; cup cup-shaped, with scales somewhat loose (rim often fringed), inclosing one-third of the nut; nut ovoid, light brown, pubescent at the apex, about 1 inch long; kernel white, sweet, edible.

WINTER-BUDS.—Terminal bud ⅛ inch long, broadly ovoid to globose, obtuse; scales light brown, pilose above the middle.

BARK.—Twigs at first lustrous, green, becoming red-brown, finally dark brown and separating into large, papery scales which curl back; thick, gray-brown on the trunk, deeply fissured into broad, flat, scaly ridges. Plate IV.

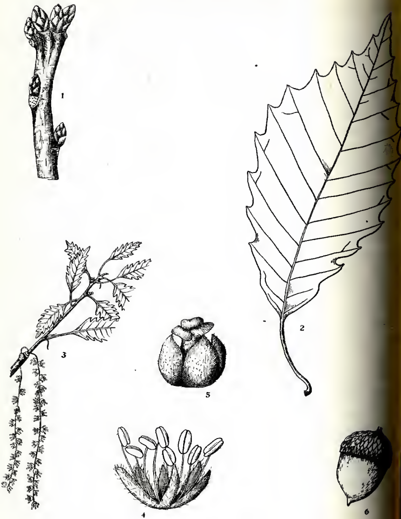
WOOD.—Heavy, hard, strong, tough, coarse-grained, light brown, with thin, indistinguishable sapwood.

DISTRIBUTION.—Frequent in the Champlain valley, especially about Lake Champlain.

HABITAT.—Prefers moist, rich soil bordering swamps and along streams.

NOTES.—In beauty and variety of grain this tree nearly equals the white oak and its wood is valuable for similar purposes. As its name suggests it grows in low, moist soil. Unfortunately the swamp oak is not found in Vermont except along the intervales of Lake Champlain and its tributaries. Here it is quite abundant and its majestic size and symmetrical, rounded top make it a conspicuous and beautiful tree. It is more easily identified than many of the oaks because of the scaly bark, the leaves downy on the lower surface and the long, downy stalks of the acorns.

Yellow Oak. Chestnut Oak



(Mich. Trees).

1. Winter twig, x 2.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

FAGACEAE

Yellow Oak. Chestnut Oak

Quercus muhlenbergii Engelm. [Quercus acuminata (Michx.) Houba]

HABIT.—A small to medium-sized tree 30-40 feet high, with a trunk diameter of 1-2 feet; erect, somewhat short branches form a narrow, rounded crown.

LEAVES.—Alternate, simple, 4-7 inches long, 1-4 inches broad; oblong-lanceolate to obovate; coarsely toothed; thick and firm; lustrous, yellow-green above, pale-pubescent beneath; petioles slender, about 1 inch long.

FLOWERS.—May, with the leaves; monoecious; the staminate in hairy catkins 3-4 inches long; the pistillate sessile or in short spikes, hoary-tomentose; calyx campanulate, 5-8-lobed, yellow, hairy; corolla 0; stamens 5-8, with yellow anthers; stigmas red.

FRUIT.—Autumn of first season; sessile or short-stalked acorns; cup with small scales, hoary-tomentose, inclosing one-half of the nut; nut ovoid, about ¾ inch long, light brown; kernel sweet, sometimes edible.

WINTER-BUDS.—Terminal bud ⅛ inch long, conical, acute; scales chestnut-brown, scarious on the margin.

BARK.—Twigs greenish at first, becoming gray-brown, finally gray or brown; thin, silvery gray or ash colored and flaky on the trunk.

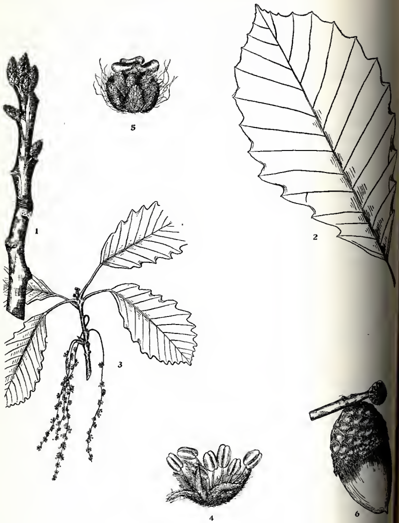
WOOD.—Heavy, very hard, strong, close-grained, durable, dark brown, with thin, pale brown sapwood.

DISTRIBUTION.—Rare; reported from Gardiner's island in Lake Champlain, Malletts Head, Ferrisburg and Colchester.

HABITAT.—Dry limestone hillsides; rocky river-banks and lake-shores.

NOTES.—This oak is a very beautiful tree and is well adapted for use in parks and on lawns on account of its handsome foliage.

Chestnut Oak



1. Winter twig, x 1.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

FAGACEAE

Chestnut Oak

Quercus prinus L.

HABIT.—A medium-sized tree 30-50 feet high, with a trunk diameter of 1-2 feet; usually dividing near the ground into a few large branches and forming a broad, open, rather irregular crown.

LEAVES.—Alternate, simple, 6-8 inches long and one-third to one-half as broad; lanceolate to obovate; coarsely crenate; thick and firm, almost leathery; glabrous, dark green above, paler and finely pubescent beneath; petioles ½-1 inch long.

FLOWERS.—May, with the leaves; monoecious; the staminate in hairy catkins 2-2½ inches long; the pistillate in short spikes on stout, pubescent peduncles; calyx deeply 7-9-lobed, pale yellow, pilose; corolla 0; stamens 7-9, with yellow anthers; stigmas dark red.

FRUIT.—Autumn of first season; short-stalked acorns; cup thin, deep, turbinate, inclosing one-half or less of the nut; scales small, thin-tipped, with thickened bases, hoary-pubescent; nut ovoid to oblong-ovoid, 1-1½ inches long, light brown; kernel sweet, but insipid.

WINTER-BUDS.—Terminal bud ¼-⅜ inch long, ovoid, sharp-pointed; scales light brown, slightly hairy toward the apex and on the margin.

BARK.—Twigs greenish, becoming orange and brown, with somewhat bitter taste; thick, dark red-brown to nearly black on old trunks, deeply fissured into thick, roughish ridges (a section through one of the ridges would resemble an inverted letter V).

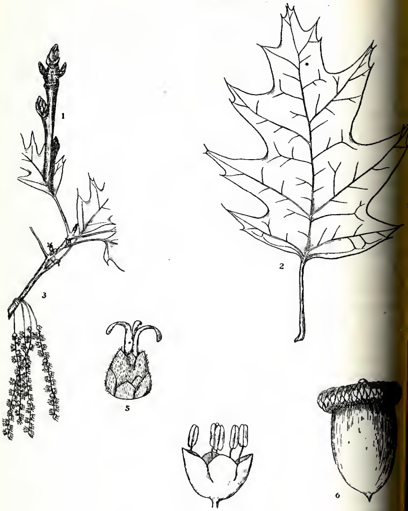
WOOD.—Heavy, hard, strong, tough, close-grained, dark brown, with thin, lighter colored sapwood.

DISTRIBUTION.—Frequent throughout the western part of Vermont from Charlotte to Pownal; abundant on Snake mountain at an altitude of 1,300 feet and on the western slopes of the Green mountains, especially in Addison county.

HABITAT.—Dry, rocky hillsides.

NOTES.—The popular name of this oak is suggested by the marked resemblance of its leaves to those of the chestnut. It is one of the common oaks from Massachusetts and New York southward, forming a large tree on rocky hillsides, often associated with the chestnut. The line of its northern distribution passes through the Champlain valley. It occurs probably also in the southeastern part of Vermont. The acorns are large, one inch or more in length. The wood is hard and tough and is used frequently for railroad ties.

Red Oak



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

FAGACEAE

Red Oak

Quercus rubra L.

Habit.—A large tree 70-80 feet high, with a trunk diameter of 2-4 feet; forming a broad, rounded crown of a few large, wide-spreading branches and slender branchlets.

Leaves.—Alternate, simple, 5-9 inches long, 4-6 inches broad; oval to obovate; 5-11-lobed with coarse-toothed, bristle-tipped lobes tapering from broad bases and wide, oblique, rounded sinuses; thin and firm; dull dark green above, paler beneath; petioles stout, 1-2 inches long.

Flowers.—May, when the leaves are half grown; monoecious; the staminate in hairy catkins 4-5 inches long; the pistillate on short, glabrous peduncles; calyx 4-5-lobed, greenish; corolla 0; stamens 4-5, with yellow anthers; stigmas long, spreading, bright green.

Fruit.—Autumn of second season; sessile or short-stalked acorns; cup shallow, saucer-shaped, inclosing only the base of the nut; scales closely appressed, more or less glossy, puberulous, bright red-brown; nut oblong-ovoid with a broad base, about 1 inch long, red-brown; kernel white, very bitter.

Winter-buds.—Terminal bud ¼ inch long, ovoid, acute, light brown, smooth.

Bark.—Twigs lustrous, green, becoming reddish, finally dark brown; young trunks smooth, gray-brown; old trunks darker, shallowly fissured into thin, firm, broad ridges; inner bark light red, not bitter. Plate V.

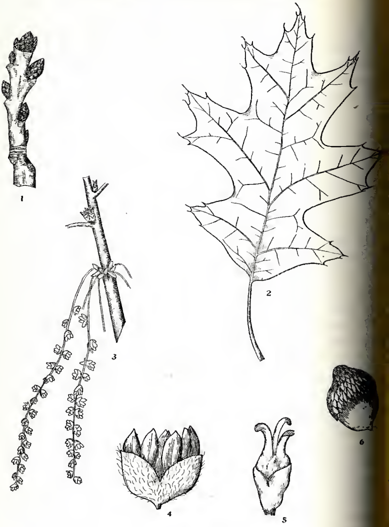
Wood.—Heavy, hard, strong, coarse-grained, light red-brown, with thin, darker colored sapwood. Page 230.

Distribution.—Common throughout Vermont at altitudes below 1,000 feet.

Habitat.—Grows well in all well-drained soils; rich and poor soil.

Notes.—The red oak is the most northern of all the oaks, ranging from Nova Scotia to Tennessee. It is distributed generally through the Champlain and lower Connecticut valleys where it is the most common oak. It is less common in the northern part of the Connecticut valley. The flowers appear in May but the sessile, shallow-cupped acorns do not ripen until the second autumn. The wood is lighter in weight and more brittle than that of the white oak but when quartered shows a beautiful grain and is used for furniture. It is valued also for bridge posts where there is to be exposure to water. The wood dries out slowly and is inferior as fuel.

Quercitron. Yellow-barked Oak. Black Oak



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

FAGACEAE

Quercitron. Yellow-barked Oak. Black Oak

Quercus velutina Lam.

Habit.—A medium-sized tree 50-60 feet high and 1-3 feet in trunk diameter; slender branches and stout branchlets form a wide-spreading, rounded crown.

Leaves.—Alternate, simple, 5-10 inches long, 3-8 inches broad; ovate to oblong; usually 7-lobed, some with shallow sinuses and broad, rounded, mucronate lobes, others with wide, rounded sinuses extending half-way to the midrib or farther and narrow-oblong or triangular, bristle-tipped lobes, the lobes more or less coarse-toothed, each tooth bristle-tipped; thick and leathery; dark green and shining above, pale and more or less pubescent beneath; petioles stout, yellow, 3-6 inches long.

Flowers.—May, when the leaves are half grown; monoecious; the staminate in pubescent catkins 4-6 inches long; the pistillate reddish, on short, tomentose peduncles; calyx acutely 3-4-lobed, reddish, hairy; corolla 0; stamens usually 4-5, with acute, yellow anthers; stigmas 3, divergent, red.

Fruit.—Autumn of second season; sessile or short-stalked acorns; cup cup-shaped or turbinate, inclosing about one-half of the nut; scales thin, light brown, hoary; nut ovoid, ½-¾ inch long, red-brown, often pubescent; kernel yellow, bitter.

Winter-buds.—Terminal bud ¼ inch long, ovoid to conical, obtuse, strongly angled, hoary-tomentose.

Bark.—Twigs at first scurfy-pubescent, later glabrous, red-brown, finally mottled gray; thick and nearly black on old trunks, deeply furrowed and scaly; inner bark thick, yellow, very bitter. Plate V.

Wood.—Heavy, hard, strong, coarse-grained, bright red-brown, with thin, paler sapwood.

Distribution.—Frequent in western Vermont and in the Connecticut valley as far north as Bellows Falls.

Habitat.—Dry, light soil; poor soils.

Notes.—The quercitron or yellow-barked oak is a southern species which reaches its northern limit in Vermont. It is not uncommon in light, dry soils in the Champlain valley and it occurs also in the southern part of the Connecticut valley. The two common and apparently incompatible names, yellow oak and black oak, arise from the diverse colors of the inner bark and the outer bark. The former, which is used in tanning, is yellow, while the later is very dark. The leaves are rather large, dark, shiny green with yellowish petioles.

THE ELMS

We are fortunate in having in Vermont all of the elms of the ern United States except one small southern species. The tiny ish flowers have no petals, but gracefully fringe the bare trees their long slender stamens in early spring before the appearance o leaves. The fruits are supplied with a disk-like membranous The leaves of all the elms have a peculiar oblique base, full rounded upon one side, sharply wedge-shaped on the other.

Introduced species.—The English elm occasionally has planted as a shade tree, although for such purposes it is less stately our common white elm. Two European varieties have been more used for ornamental plantings, though each of them is curious rather than ornamental. These are the corky variety of the English elm, and Camperdown or weeping elm, which is a variety of the Scotch elm. The young branches of the former are covered with conspicuous corky outgrowths, similar to those of the native cork elm, but more strongly developed. The American cork elm is distinguished from the English elm by its more downy bud-scales and by the production of flowers elongated clusters (racemes), whereas those of the English elm are close clusters. Other differences will be detected readily by those having occasion to compare the two trees. The weeping elm usually reverse-grafted on an upright stock, leading to a peculiar umbrella-like development.

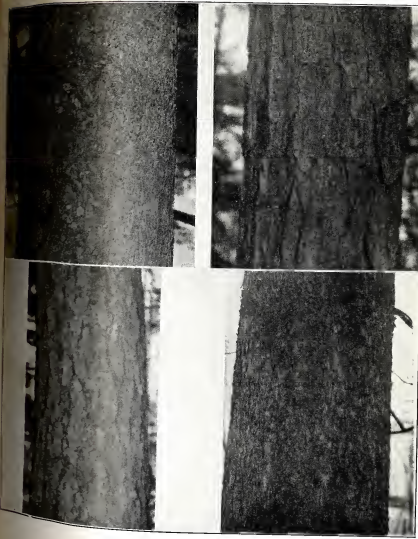


PLATE I.

White Pine
Red Pine

Pitch Pine
Tamarack

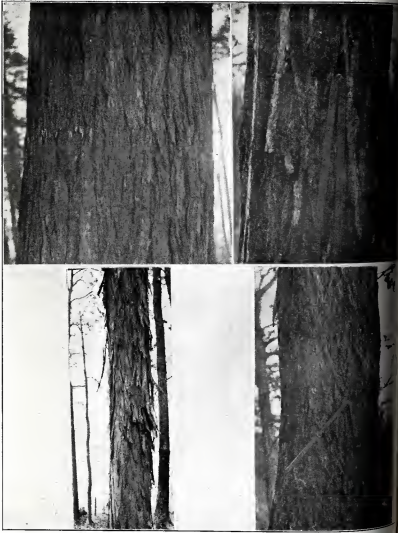


PLATE II.

Hemlock Butternut

Shellbark Hickory Pignut

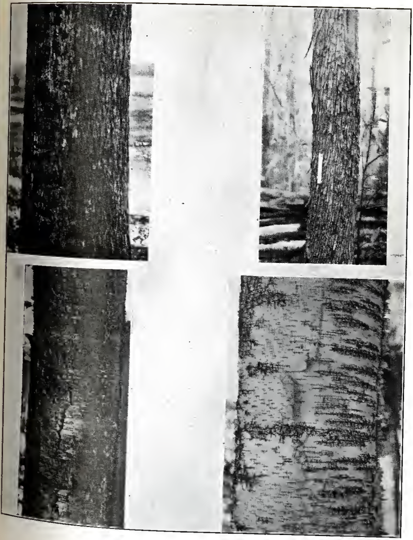


PLATE III.

Bitternut

Yellow Birch

Hornbeam

White Birch

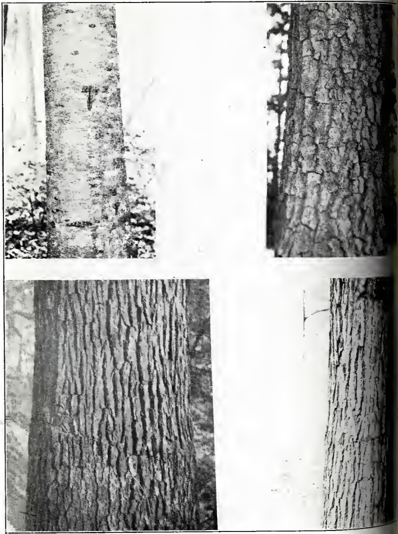


Plate IV.

Beech
White Oak

Chestnut
Swamp White Oak

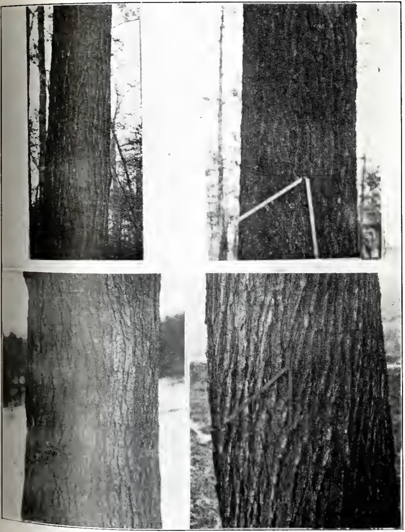


PLATE V.

Red Oak
Black Oak
Slippery Elm
American Elm

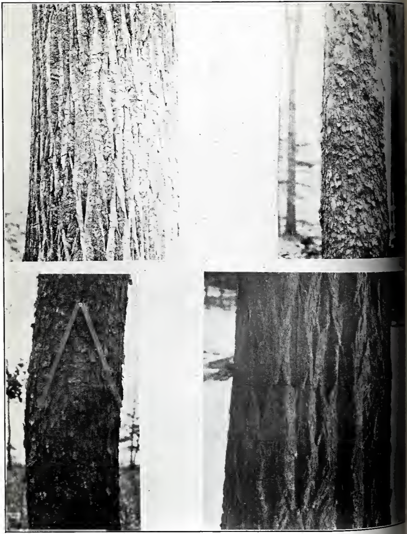


PLATE VI.

Tulip Poplar — Sycamore

Black Cherry — Black Locust

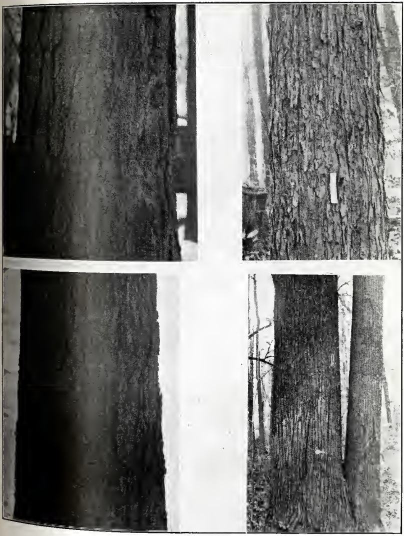


PLATE VII.

Sugar Maple
Red Maple

Silver Maple
Basswood

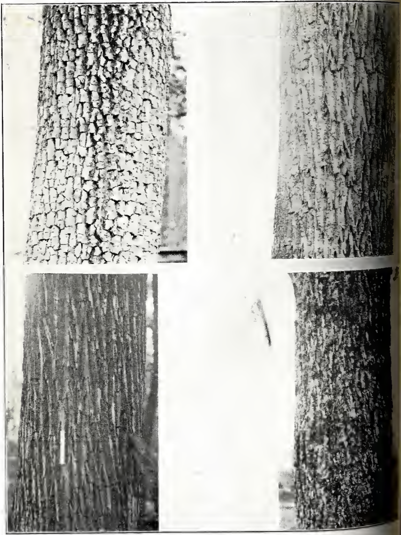


PLATE VIII.

Black Gum
White Ash

Red Ash
Black Ash

SUMMER KEY TO THE SPECIES OF ULMUS

a. Leaves essentially smooth on both sides; branches often with corky, wing-like ridges; lowermost branches usually short and strongly drooping; main trunk usually continuous into the crown without dividing, giving to the tree a narrow-oblong outline,

U. racemosa, p. 135.

aa. Leaves usually rough on one or on both sides; branches without corky ridges; lowermost branches not short, not strongly drooping; main trunk usually dividing into several large limbs, giving to the tree a more or less vase-shaped outline.

b. Leaves usually rough above, but smooth beneath, with petioles glabrous; bark of trunk gray, deeply fissured into broad, scaly ridges; inner bark not mucilaginous. . . . **U. americana,** p. 133.

bb. Leaves usually rough both sides, with petioles hairy; bark of trunk dark red-brown, shallowly fissured into large, loose plates; inner bark mucilaginous . . . . **U. fulva,** p. 131.

WINTER KEY TO THE SPECIES OF ULMUS

a. Buds conspicuously rusty-tomentose; twigs more or less pubescent; inner bark very mucilaginous when chewed. . . . **U. fulva,** p. 131.

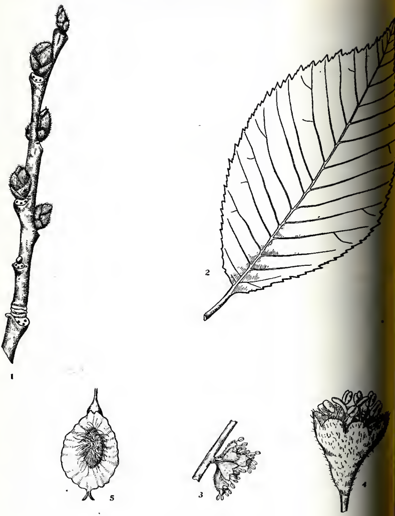
aa. Buds not conspicuously rusty-tomentose; twigs glabrous; inner bark not mucilaginous.

b. Bundle-scars usually 3; buds ⅛ inch long, glabrous; twigs without corky ridges; outline of tree vase-shaped,

U. americana, p. 133

bb. Bundle-scars usually 4-6 in a curved line; buds ¼ inch long, somewhat pilose; twigs often with corky ridges; outline of tree narrow-oblong . . . . **U. racemosa,** p. 135.

Slippery Elm. Red Elm



(Mich. Trees).

1. Winter twig, x 2.
2. Leaf, x 1.
3. Flowering branchlet, x 1.
4. Perfect flower, enlarged.
5. Fruit, x 1.

URTICACEAE

Slippery Elm. Red Elm

Ulmus fulva Michx. [Ulmus pubescens Walt.]

HABIT.—A medium-sized tree 40-60 feet high, with a short trunk 1-2 feet in diameter; spreading branches form a broad, open, flat-topped crown.

LEAVES.—Alternate, simple, 4-7 inches long, about one-half as broad; ovate-oblong; coarsely doubly serrate; thick and firm; dark green and rough above, paler and somewhat rough beneath; petioles short, stout, hairy.

FLOWERS.—April, before the leaves; mostly perfect; borne on short pedicels in crowded fascicles; calyx campanulate, 5-9-lobed, green, hairy; corolla 0; stamens 5-9, with dark red anthers; stigmas 2, reddish purple.

FRUIT.—May; semi-orbicular, 1-seeded samaras, short-stalked in dense clusters; seed cavity brown-tomentose; wings smooth, nearly ¾ inch long.

WINTER-BUDS.—Terminal bud absent; lateral buds ovoid, obtuse, dark brown, rusty-tomentose, ¼ inch long.

BARK.—Twigs at first bright green and pubescent, becoming light to dark brown or grayish; thick on old trunks, dark red-brown, shallowly fissured into large, loose plates; inner bark mucilaginous. Plate V.

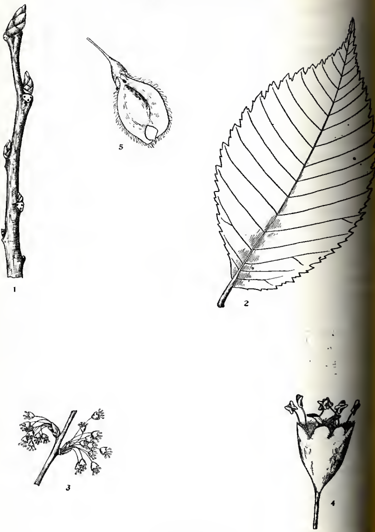
WOOD.—Heavy, hard, strong, very close-grained, durable, easy to split while green, dark red-brown, with thin, lighter colored sapwood.

DISTRIBUTION.—Occasional throughout Vermont.

HABITAT.—Rich, rocky woods.

NOTES.—The slippery elm is not uncommon in Vermont. The scattering trees of this species, however, usually are passed unnoticed because it resembles the American elm so closely that it is not easy to distinguish the two by general appearance. The stringy mucilaginous bark of the slippery elm always is a sure means of recognition. Other means of distinguishing it are found in its circular fruits, which appear in May; these have smooth margins, whereas those of both the other species are fringed with delicate hairs. The leaves are large, rough above and soft-downy beneath. But the surest and simplest test is the "slippery" bark. This has well-known medicinal properties which give it a recognized value in the drug trade. The slippery elm is usually found on rocky ridges and hillsides.

American Elm. White Elm



(Mich. Trees).

1. Winter twig, x 2.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Flower, enlarged.
5. Fruit, x 2.

URTICACEAE

American Elm. White Elm

Ulmus americana L.

HABIT.—A tree 75-100 feet high, with a trunk diameter of 2-6 feet; commonly dividing 20-30 feet above the ground into a few large branches which rise upward and outward to form a vase-shaped outline.

LEAVES.—Alternate, simple, 4-6 inches long, one-half as broad; obovate-oblong to oval; coarsely doubly serrate; thick and firm; dark green and rough above, pale and pubescent or glabrous beneath; petioles short and stout.

FLOWERS.—April, before the leaves; mostly perfect; small, brown to red; borne on slender pedicels in loose fascicles; calyx campanulate, 5-9-lobed; corolla 0; stamens 4-9, with bright red anthers; ovary 2-celled; styles 2, green.

FRUIT.—May; ovate, 1-seeded samaras, smooth both sides, hairy on the margin, ½ inch long, long-stemmed in crowded clusters.

WINTER-BUDS.—Terminal bud absent; lateral buds ovoid, acute, flattened, glabrous, brown, ⅛ inch long.

BARK.—Twigs at first light green and downy, becoming glabrous, red-brown, finally ash-gray; on old trunks thick, ash-gray, deeply fissured into broad, scaly ridges. Plate V.

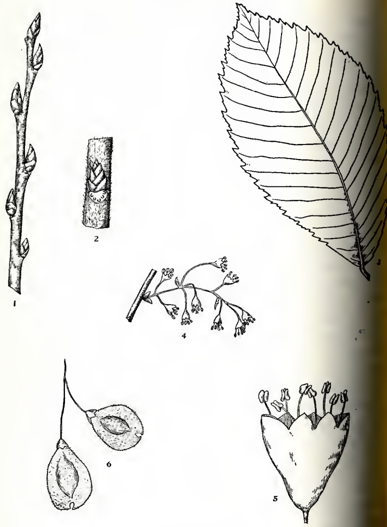
WOOD.—Heavy, hard, strong, tough, difficult to split, coarse-grained, light brown, with thick, lighter colored sapwood. Page 225.

DISTRIBUTION.—Common throughout Vermont.

HABITAT.—Prefers deep, rich, moist loam; bottom-lands; stream-banks.

NOTES.—Of all the native trees none has done more than the white elm to beautify the streets of our cities and villages or to grace our country hillsides and meadows. The spreading vase-shaped head is its typical form, but perfect trees are found only where there has been a free development of the branches from the sapling age. Even when developing freely, however, the trees vary markedly in form. Some may be found which are very strict and upright others which are straggling and strongly weeping. The bark characters also vary much in different trees. Numerous clusters of slender, drooping flowers open before the leaves in early May, giving the tree a delicate feathery appearance. The seeds mature and fall before the leaves are grown fully. The wood is very tough and fibrous, making it useful for ox yokes, wagon bolsters, hubs of wheels and similar purposes where there is special cross-strain.

Cork Elm



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Flowering branchlet, x 1.
5. Flower, enlarged.
6. Fruit, x 1.

URTICACEAE

Cork Elm

Ulmus racemosa Thomas [Ulmus Thomasi Sarg.]

Habit.—A large tree reaching a height of 50-75 feet and a trunk diameter of 2-3 feet; strongly drooping lateral and lower branches form a narrow, oblong crown.

Leaves.—Alternate, simple, 3-6 inches long, one-half as broad; obovate to oblong-oval, more or less dished; coarsely doubly serrate; thick and firm; lustrous, dark green above, pale-pubescent beneath; petioles pubescent, ¼ inch long.

Flowers.—April-May, before the leaves; mostly perfect; greenish; borne on slender, drooping pedicels in loose racemes; calyx campanulate, 7-8-lobed; corolla 0; stamens 7-8, with purple anthers; ovary hairy, 2-styled.

Fruit.—May-June; ovate, 1-seeded samaras, pubescent all over, ½ inch long.

Winter-buds.—Terminal bud absent; lateral buds ovoid, acute, brown, pilose, ¼ inch long.

Bark.—Twigs at first light brown and pubescent, becoming lustrous, red-brown, finally gray-brown with corky, wing-like ridges; thick and grayish on the trunk, with wide fissures separating broad, flat, scaly ridges.

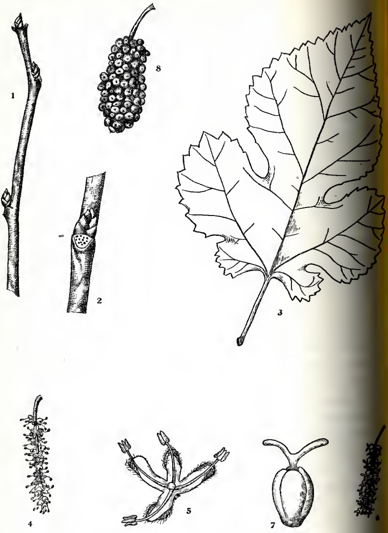
Wood.—Heavy, very strong and tough, close-grained, light red-brown, with thick, lighter colored sapwood.

Distribution.—Western Vermont, west of the Green mountains, becoming relatively more abundant in the Champlain valley; rare.

Habitat.—River-banks and limestone soils.

Notes.—The cork elm is a more valuable timber tree but it is found only in the limestone soils of western Vermont, and there but rarely. Its peculiarity is a growth of corky ridges which sometimes project for half an inch or more from all sides of the younger branches. The leaves resemble those of the white elm but are more conspicuously downy upon the under side along the midribs. The bud-scales are also downy and the young branchlets somewhat so, whereas those of the white elm are smooth. The flowers are borne in open branching clusters, or racemes, and this characteristic gives the Latin name to the species. The fruit matures when the leaves are half grown.

Red Mulberry



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Spike of staminate flowers, x 1.
5. Staminate flower, enlarged.
6. Spike of pistillate flowers, x 1.
7. Pistillate flower, enlarged.
8. Fruit, x 1.

URTICACEAE

Red Mulberry

Morus rubra L.

Habit.—A small tree 15-20 feet high, with a short trunk 10-15 inches in diameter; forming a dense, rough-topped crown of stout, spreading branches and more or less zigzag, slender branchlets.

Leaves.—Alternate, simple, 3-5 inches long, nearly as broad; outline variable, ovate to semiorbicular, often 3-5-lobed; coarsely serrate; thin; dark blue-green and smooth or rough above, pale and more or less downy beneath; petioles 1-2 inches long, smooth, exuding a milky juice when cut.

Flowers.—May, with the leaves; monoecious or dioecious; the staminate in dense spikes 1-2 inches long, on short, hairy peduncles; the pistillate in dense spikes about 1 inch long, on short, hairy peduncles; calyx 4-lobed, hairy; corolla 0; stamens 4, with green anthers; stigmas 2, spreading.

Fruit.—July; 1 inch long; consisting of drupes about $\frac{1}{32}$ inch long, each inclosed in a thickened, fleshy calyx; berry-like; bright red at first, finally blackish; sweet, juicy, edible.

Winter-buds.—Terminal bud absent; lateral buds ovoid, abruptly pointed, $\frac{1}{4}$ inch long, lustrous, light brown.

Bark.—Twigs greenish and more or less downy, becoming smooth and brownish; trunk dark brown tinged with red and more or less furrowed.

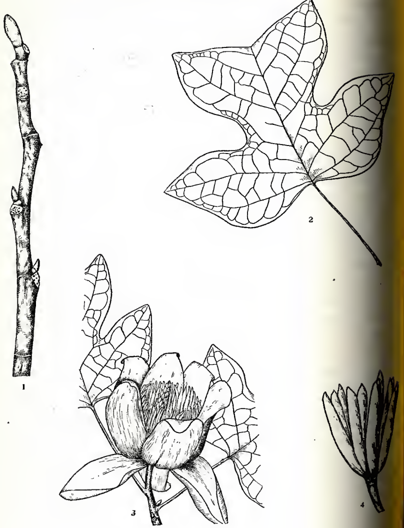
Wood.—Light, soft, weak, rather tough, coarse-grained, very durable, pale orange, with thick, lighter colored sapwood.

Distribution.—Rare; reported from Pownal and North Pownal in the Hoosic valley.

Habitat.—Prefers rich soil in river-bottoms; rich woods.

Notes.—The name mulberry is applied very commonly in Vermont to one of the wild raspberries, which has a conspicuous rose-like blossom followed by a reddish raspberry fruit. This shrub should be called the purple flowering raspberry since the true mulberries are trees. Two species of mulberry occur in Vermont; of these, the red is native, and the white is introduced, and occasionally is an escape. The fruit of both is edible, somewhat resembling that of the blackberry in size and appearance. The leaves are heart-shaped or ovate, often cut into curiously irregular lobes so that no two leaves on a branch will be exactly alike. This irregularity in leaf-form, together with the peculiar fruit, makes the recognition of the mulberry easy. Often it difficult to distinguish the two species.

Tulip Tree. Yellow Poplar. Whitewood



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Fruit (opened and partly disseminated), x ½.

MAGNOLIACEAE

Tulip Tree. Yellow Poplar. Whitewood

Liriodendron tulipifera L.

HABIT.—A large tree 50-70 feet high, with a columnar trunk 2-3 feet in diameter; forming a rather open, conical crown of slender branches.

LEAVES.—Alternate, simple, 5-6 inches long and broad; 4-lobed; entire; lustrous, dark green above, pale or glaucous beneath, turning clear yellow in autumn; petioles slender, angled, 5-6 inches long.

FLOWERS.—June, after the leaves; perfect; terminal; solitary on stout peduncles; tulip-shaped, greenish yellow, 1½-2 inches long; sepals 3, greenish, early deciduous; petals 6, in 2 rows, greenish yellow with an orange spot at the base, early deciduous; stamens numerous, somewhat shorter than the petals; pistils numerous, clinging together about a central axis; ovary 1-celled.

FRUIT.—September-October; a narrow, light brown cone 2½-3 inches long, composed of numerous carpels; carpels long, flat, with a 1-2-seeded nutlet at the base, separating from the slender spindle at maturity.

WINTER-BUDS.—Terminal bud ½-1 inch long, obtuse, flattish, dark red, covered with a glaucous bloom.

BARK.—Twigs smooth, lustrous, reddish, becoming brownish, and at length gray; ashy gray, thin and scaly on young trunks, becoming thick, brownish, and deeply furrowed with age. Plate VI.

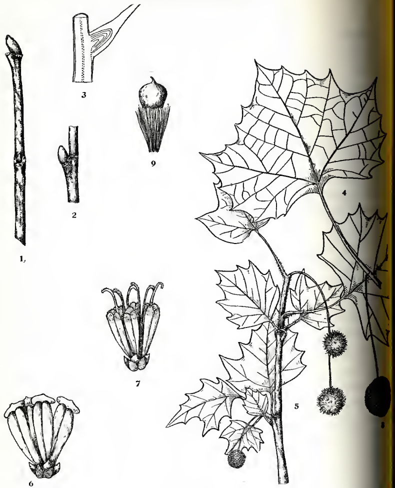
WOOD.—Light, soft, brittle, weak, easily worked, light yellow or brown, with thin, cream-white sapwood.

DISTRIBUTION.—Hoosic valley in southwestern Vermont; rare.

HABITAT.—Prefers deep, rich, rather moist soil, but adapts itself readily to any good, light soil.

NOTES.—The tulip tree is included in this list of native Vermont trees, although few native trees can be pointed out. The tree was reported authentically in the Appendix to Thompson's "Vermont" in 1853. It then occurred occasionally in Bennington county along the Hoosic valley. A single native specimen of this species is reported from North Pownal by Eggleston, showing that it is not yet extinct. It is to be hoped that tree lovers located in that portion of Vermont will learn and more fully report upon its present distribution, as this region marks its northern limit as a native tree. It thrives, however, as a shade tree planted in Rutland and Burlington. An attractive feature of this tree is its display of tulip-like flowers which open in June.

Sycamore. Buttonwood



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, side view, x 1.
3. Vertical section of twig, summer bud and leaf petiole, enlarged.
4. Leaf, x ⅜.
5. Flowering branchlet, x ½.
6. Staminate flower, enlarged.
7. Pistillate flower, enlarged.
8. Fruit, x ⅜.
9. Achene, enlarged.

PLATANACEAE

Sycamore. Buttonwood

Platanus occidentalis L.

HABIT.—A large tree 50-80 feet high, with a trunk diameter of 3-5 feet; commonly dividing near the ground into several large secondary trunks, forming a broad, open, irregular crown of massive, spreading branches.

LEAVES.—Alternate, simple, 5-10 inches long and broad; broadly ovate in outline; more or less 3-5-lobed by broad, shallow sinuses, the lobes sinuate-toothed; thin and firm; bright green above, paler beneath, glabrous both sides; petioles stout, puberulous, 1-2 inches long.

FLOWERS.—May, with the leaves; monoecious; borne in dense heads; the staminate dark red, on short, axillary peduncles; the pistillate greenish, on long, slender, terminal peduncles; sepals 3-6, minute; petals 3-6, minute; stamens 3-6, usually 4; styles long, incurved, red.

FRUIT.—October, persistent on the limbs through the winter; brown heads about 1 inch in diameter, on slender, glabrous stems 3-6 inches long.

WINTER-BUDS.—Terminal bud absent; lateral buds ¼-⅜ inch long, conical, blunt, lustrous, pale brown; forming in summer within the petiole of the leaf.

BARK.—Twigs pale green and tomentose, becoming smooth, dark green, finally grayish; thick, red-brown on the trunk and broken into oblong, plate-like scales, separating higher up into thin plates which peel off, exposing the greenish or yellowish inner bark. · Plate VI.

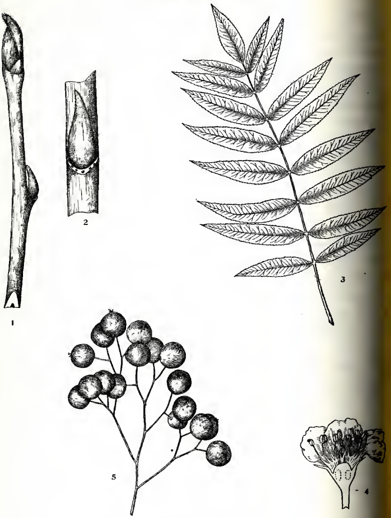
WOOD.—Heavy, tough, hard, rather weak, coarse-grained, difficult to split, light red-brown, with thick, darker colored sapwood.

DISTRIBUTION.—Occasional to frequent in the Champlain valley and along the tributary rivers, becoming abundant in the Hoosic valley in southwestern Vermont; Connecticut valley as far north as Hartford.

HABITAT.—Rich bottom-lands along the borders of rivers and lakes.

NOTES.—The bark unmistakably characterizes this species. On old trees this is brown and rough on the lower parts of the trunks, but above and on the branches it is smoother, with great, irregular, whitish or pale yellowish patches where the outer layers have scaled off, leaving the inner bark exposed. This gives the tree a whitewashed appearance when seen from a short distance.

American Mountain Ash



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ⅓.
4. Vertical section of flower, enlarged.
5. Portion of a fruiting cyme, x 1.

ROSACEAE

American Mountain Ash

Pyrus americana (Marsh.) DC. [Sorbus americana Marsh.]

HABIT.—A small tree 20-30 feet high, with a trunk diameter of 12-15 inches; branches slender, spreading, forming a narrow, rounded crown.

LEAVES.—Alternate, compound, 6-9 inches long. Leaflets 9-17, 2-3 inches long and ½-¾ inch broad; sessile or nearly so, except the terminal; lanceolate to oblong-lanceolate, taper-pointed; finely and sharply serrate above the entire base; membranaceous; glabrous, dark yellow-green above, paler beneath, turning clear yellow in autumn. Petioles slender, grooved, enlarged at the base.

FLOWERS.—May-June, after the leaves; perfect; ⅛ inch across; borne on short, stout pedicels in many-flowered, flat cymes 3-5 inches across; calyx urn-shaped, 5-lobed, puberulous; petals 5, white; stamens numerous; styles 2-3.

FRUIT.—October, but persistent on the tree throughout the winter; a berry-like pome, subglobose, ¼ inch in diameter, bright red, with thin, acid flesh; eaten by birds in the absence of other food.

WINTER-BUDS.—Terminal bud about ½ inch long, ovoid, acute, with curved apex; lateral buds smaller, appressed; scales rounded on the back, purplish red, more or less pilose above, gummy.

BARK.—Twigs at first red-brown and hairy, becoming glabrous, dark brown; thin, light gray-brown on the trunk, smooth, or slightly roughened on old trees; inner bark fragrant.

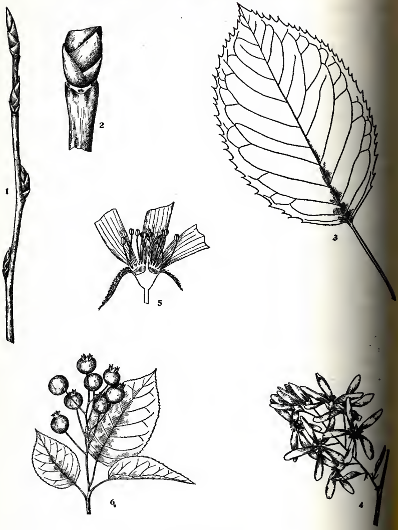
WOOD.—Light, soft, close-grained, weak, pale brown, with thick, lighter colored sapwood.

DISTRIBUTION.—Frequent throughout Vermont, becoming common in the mountainous sections.

HABITAT.—Rich, moist soil on river-banks and on the borders of cold swamps; rocky hillsides and mountains.

NOTES.—This is one of the most beautiful trees of our northern forests. It is conspicuous among our trees for broad, flat-topped clusters of creamy white flowers followed by the persistent scarlet fruits. The common name is suggested by the general resemblance of the compound leaf to that of the ashes. In reality these trees are very closely related to the cultivated apples and pears, a fact which will become evident if one examines the structure of either the flower or the apple-like fruit. The European mountain ash, *Pyrus aucuparia (L.) Ehrh.* is planted commonly in Vermont for ornamental purposes and plants of this species are abundantly spontaneous in several localities.

Shadbush. Juneberry. Service Berry



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Flowering branchlet, x ½.
5. Vertical section of flower, enlarged.
6. Fruiting branchlet, x ½.

ROSACEAE

Shadbush. Juneberry. Service Berry

Amelanchier canadensis (L.) Medic.

HABIT.—A shrub or small tree 15-30 feet in height, with a tall trunk 6-12 inches in diameter; forming a narrow, rounded crown of many small limbs and slender branchlets.

LEAVES.—Alternate, simple, 3-4 inches long and about one-half as broad; ovate to obovate; finely and sharply serrate; glabrous, dark green above, paler beneath; petioles slender, about 1 inch long.

FLOWERS.—April-May, when the leaves are about one-third grown; perfect; large, white, borne in drooping racemes 3-5 inches long; calyx 5-cleft, campanulate, villous on the inner surface; petals 5, strap-shaped, white, about 1 inch in length; stamens numerous; styles 5, united below.

FRUIT.—June-August; globular, berry-like pome, $\frac{1}{3}$-$\frac{1}{2}$ inch long; turning from bright red to dark purple with slight bloom; sweet and edible when ripe.

WINTER-BUDS.—Yellow-brown, narrow-ovoid to conical, sharp-pointed, $\frac{1}{4}$-$\frac{1}{2}$ inch long; bud-scales apiculate, slightly pubescent.

BARK.—Twigs smooth, light green, becoming red-brown; thin, pale red-brown on the trunk, smoothish or divided by shallow fissures into narrow, longitudinal, scaly ridges.

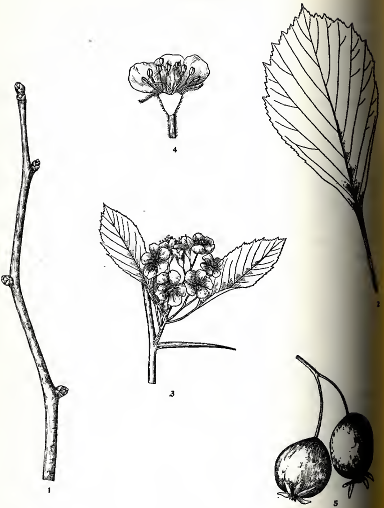
WOOD.—Heavy, very hard, strong, close-grained, dark red-brown, with thick, lighter colored sapwood.

DISTRIBUTION.—Common throughout Vermont, especially in the Champlain valley.

HABITAT.—Dry, upland woods and hillsides; light soils.

NOTES.—Several other species occur in Vermont, most of which are shrubs below tree height. One is a small tree, however, becoming shrubby in the north. It differs but slightly from *Amelanchier canadensis* and until recently has not been distinguished from it. This new species has been named *Amelanchier laevis Wiegand*. It is said to be more northerly in its distribution than *Amelanchier canadensis*. The shadbush is easily recognized by its graceful white flowers which appear in the most lavish profusion in May before those of any other native fruit tree. The fruits which ripen in June are nearly one-half an inch long, purple, sweet and edible, but the birds make way with them so quickly that they are not often to be found. The shadbush is common in light soils and dry woodlands throughout Vermont, and especially so in parts of the Champlain valley. It ranges in size and habit from a bush to a small tree twenty to thirty feet in height.

Dotted Haw



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x 1.
3. Flowering branchlet, x ½.
4. Vertical Section of flower, enlarged.
5. Fruit, x 1.

ROSACEAE

Hawthorns or Thorn-apples

Crataegus L.

Owing to the complexity of the various forms in this group, the present state of uncertainty as to the value of certain characters, and the questionable validity of many of the assigned names, it is thought to be beyond the scope of this bulletin to give more than a general description of the group as a whole, recommending the more ambitious student to the various manuals and botanical journals and papers for more detailed information.

The *Crataegi* are generally low, wide-spreading trees or shrubs, with strong, tortuous branches and more or less zigzag branchlets usually armed with stiff, sharp thorns. The bark varies from dark red to gray and is shallowly fissured or scaly. The leaves are alternate, simple, generally serrate, often lobed, with short or long petioles. The flowers appear in May or June, with or after the leaves, in simple or compound corymbs, whitish or pinkish, perfect. The fruit is a red to yellow, sometimes blue or black pome, subglobose to pear-shaped, with usually dry and mealy flesh and 1-5 seeds. The winter-buds are small, nearly globose, lustrous brown. *Crataegus* produces wood which is heavy, hard, tough, close-grained, red-brown, with thick, pale sapwood. The hawthorns are trees of the pasture-lands, the roadside, the open woods and the stream-banks, and are more common in the southern part of Vermont and in the lower altitudes, although some few species extend northward into Canada and some are found at considerable altitudes. Some of the species are desirable as ornaments in parks and gardens on account of their beautiful and abundant flowers and showy fruits.

THE PLUMS AND CHERRIES

The plums and cherries, particularly when in blossom, are among the most attractive trees in New England. They are all of small or medium size with conspicuous pink or white flowers. They are distinguished by their stone fruit and by their astringent bark and leaves. Seven species are found in Vermont. Only four of these are described in this bulletin. One of these, the choke cherry, seldom attains to the size or habit of a tree, but it is deemed best to include it here since it occurs so commonly along with the tree species that the omission might lead to some confusion.

SUMMER KEY TO THE SPECIES OF PRUNUS

a. Leaves oblong-ovate to obovate, abruptly acuminate at the apex; marginal teeth not incurved.

b. Margin of leaves sharp-serrate with spreading teeth; leaves not rugose, the veins not prominent; fruit ¼-½ inch long, bright red, racemose, July-August; bark of trunk brown, smooth or only slightly fissured; usually a large shrub, **P. virginiana,** p. 153.

bb. Margin of leaves crenate-serrate; leaves more or less rugose, the veins prominent; fruit about 1 inch long, orange-red, clustered, August-September; bark of trunk gray-brown, early splitting off in large, thick plates; a small tree...........**P. nigra,** p. 157.

aa. Leaves oval to oblong-lanceolate, taper-pointed at the apex; marginal teeth incurved.

b. Fruit light red, clustered, July-August; twigs usually less than 1/16 inch thick; pith of twigs brown... **P. pennsylvanica,** p. 155.

bb. Fruit black, racemose, August-September; twigs usually more than 1/16 inch thick; pith of twigs white...**P. serotina,** p. 151.

WINTER KEY TO THE SPECIES OF PRUNUS

a. Terminal bud present; bark of young trunks rather smooth.

b. Buds clustered at the tips of all shoots; twigs usually less than 1/16 inch thick; pith of twigs brown. .**P. pennsylvanica,** p. 155.

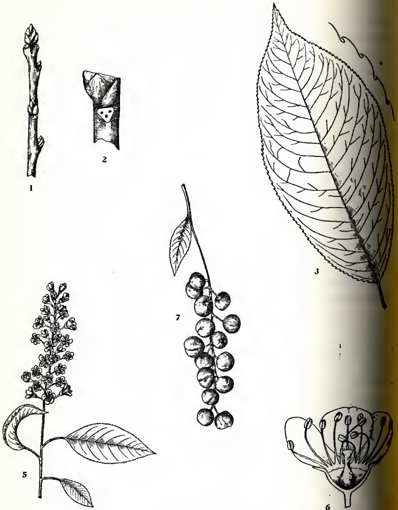
bb. Buds not clustered, or clustered only on short, spur-like branchlets; twigs usually more than 1/16 inch thick; pith of twigs white.

c. Buds usually ¼ inch or less in length; bud-scales uniform in color, apiculate at the apex; bark on old trunks blackish, rough-scaly; small to large tree..............**P. serotina,** p. 151.

cc. Buds usually ¼-½ inch long; bud-scales grayish on the margins, rounded at the apex; bark on old trunks brown, smooth or only slightly fissured; usually a large shrub, **P. virginiana,** p. 153.

aa. Terminal bud absent; bark of young trunks early splitting off in large, thick plates ....**P. nigra,** p. 157.

Black Cherry



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ¾.
4. Margin of leaf, enlarged.
5. Flowering branchlet, x ½.
6. Vertical section of flower, enlarged.
7. Fruiting branchlet, x ½.

ROSACEAE

Black Cherry

Prunus serotina Ehrh. [Padus serotina (Ehrh.) Agardh.]

HABIT.—A medium-sized tree 30-50 feet high and 8-24 inches in trunk diameter; branches few, large, tortuous, forming a rather spreading, oblong or rounded crown.

LEAVES.—Alternate, simple, 2-5 inches long, about one-half as broad; oval or oblong to oblong-lanceolate; finely serrate, with teeth incurved; subcoriaceous; dark green and very lustrous above, paler beneath, glabrous both sides; petioles short, slender, usually bearing 2 red glands near the blade.

FLOWERS.—May-June, when the leaves are half grown; perfect; ¼ inch across; borne on slender pedicels in many-flowered, loose racemes 4-5 inches long; calyx cup-shaped, 5-lobed; petals 5, white; stamens 15-20; stigma thick, club-shaped.

FRUIT.—August-September; a globular drupe, ⅓-½ inch in diameter, nearly black, with dark purple, juicy flesh; slightly bitter, edible.

WINTER-BUDS.—Terminal bud about ¼ inch long, ovoid, blunt to acute; scales keeled on the back, apiculate, light brown.

BARK.—Twigs and branches red to red-brown; young trunks dark red-brown, smooth; blackish on old trunks and rough, broken into thick, irregular plates; bitter, aromatic. Plate VI.

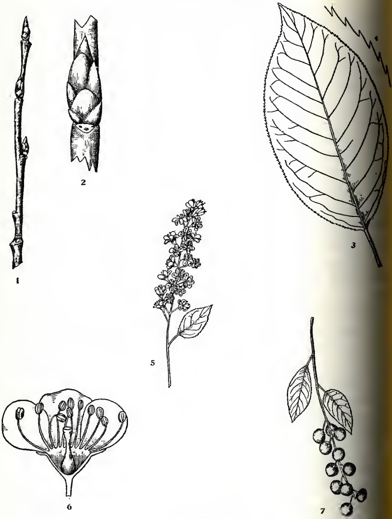
WOOD.—Light, rather hard, strong, close- and straight-grained, light brown or red, with thin, yellow sapwood.

DISTRIBUTION.—Common throughout Vermont.

HABITAT.—Woodlands; in all sorts of soils and exposures.

NOTES.—This is the only native Vermont cherry which reaches a sufficient size to make it a valuable timber tree. It has been exported in considerable quantities from the southern part of Vermont, but now large trees are seldom found. The wood is of very superior quality for cabinet making, and commands the highest price of any native American timber. It has a beautiful grain and takes a very fine polish. The flowers resemble other cherry blossoms and are borne in racemes. The fruit at first is dark red, then becomes almost black, with a thick skin and dark juicy flesh, which generally is rather bitter but sometimes sweet and pleasant.

Choke Cherry



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Margin of leaf, enlarged.
5. Flowering branchlet, x ½.
6. Vertical section of flower, enlarged.
7. Fruit, x ½.

ROSACEAE

Choke Cherry

Prunus virginiana L. [Padus virginiana (L.) Roemer]

HABIT.—Usually a large shrub, but sometimes a small tree 15-25 feet high, with a crooked, often leaning trunk 5-6 inches in diameter; forming a spreading, somewhat rounded crown.

LEAVES.—Alternate, simple, 2-4 inches long, one-half as broad; obovate to oblong-obovate or oval, abruptly acuminate at the apex; finely and sharply serrate; dull dark green above, paler beneath, glabrous both sides; petioles short, slender, glandular at the apex.

FLOWERS.—May-June, when the leaves are half grown; perfect; about ½ inch across; borne on short, slender pedicels in many-flowered racemes 3-6 inches long; calyx cup-shaped, 5-lobed; petals 5, white; stamens 15-20; stigma broad, on a short style.

FRUIT.—July-August; a globular drupe, ¼-½ inch in diameter, usually bright red, often yellow to almost black, with dark red flesh; astringent, but edible.

WINTER-BUDS.—Terminal bud ¼-½ inch long, conical, acute; scales rounded at the apex, light brown, smooth.

BARK.—Twigs at first light brown or greenish, becoming red-brown, finally dark brown; thin, dark brown on the trunk, slightly fissured.

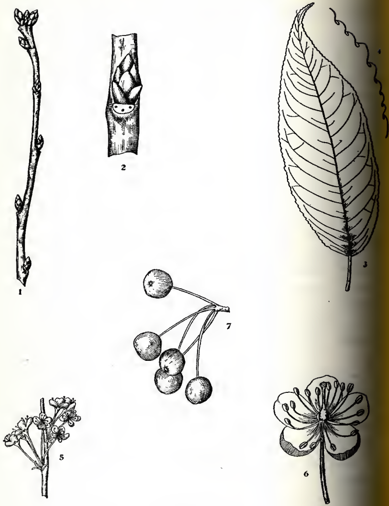
WOOD.—Heavy, hard, close-grained, weak, light brown, with thick, lighter colored sapwood.

DISTRIBUTION.—Common throughout Vermont, even on the higher mountains.

HABITAT.—Fence-rows, woods and banks.

NOTES.—The choke cherry is the most widely distributed tree of North America, extending from the Arctic circle to Mexico, from the Rocky mountains to the Atlantic ocean. *Prunus virginiana leucocarpa*, a variety with short, dense racemes of flowers and sweet, yellowish fruit, has been reported from Lunenburg and Franklin. The choke cherry usually is a shrub in Vermont. It is included, however, in this list of trees because of its close relationship to the other cherries. In May, when the leaves are half grown, it is covered with creamy white flowers in long nodding clusters. The peculiarly astringent fruit, varying greatly in quality, however, ripens abundantly in August. It makes a good quality of jelly.

Wild Red Cherry. Bird Cherry. Pin Cherry



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Margin of leaf, enlarged.
5. Flowering branchlet, x ½.
6. Flower, enlarged.
7. Fruit, x 1.

ROSACEAE

Wild Red Cherry. Bird Cherry. Pin Cherry

Prunus pennsylvanica L. f.

HABIT.—A slender tree, seldom over 30 feet high, with a trunk diameter of 8-10 inches; crown rather open, narrow, rounded, with slender, regular branches.

LEAVES.—Alternate, simple, 3-5 inches long, ¾-1¼ inches broad; oblong-lanceolate; finely and sharply serrate; bright green and shining above, paler beneath; petioles slender, ½-1 inch long, glandular near the blade.

FLOWERS.—April-May, with the leaves; perfect; about ½ inch across, borne on slender pedicels in 4-5-flowered umbels, generally clustered, 2-3 together; calyx 5-cleft, campanulate; petals 5, white, ¼ inch long; stamens 15-20.

FRUIT.—July-August; a globular drupe, ¼ inch in diameter, light red, with thick skin and sour flesh.

WINTER-BUDS.—Terminal bud ⅛ inch long, broadly ovoid, rather blunt, brownish, smooth.

BARK.—Twigs at first lustrous, red, marked by orange colored lenticels, becoming brownish; red-brown and thin on the trunk, peeling off horizontally into broad, papery plates; bitter, aromatic.

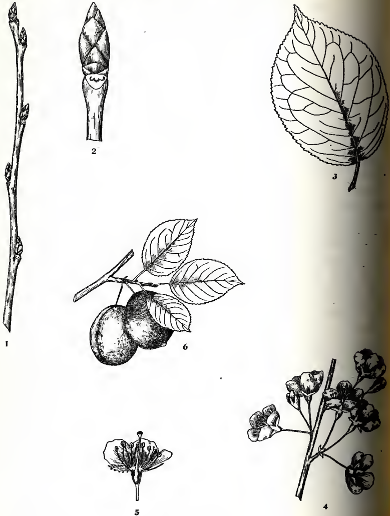
WOOD.—Light, soft, close-grained, light brown, with thin, yellow sapwood.

DISTRIBUTION.—Common throughout Vermont, even on the higher mountains.

HABITAT.—Roadsides; burned-over lands; clearings; hillsides.

NOTES.—The wild red cherry, a small, slender tree, is distributed quite generally from the rocky woods of Newfoundland to North Carolina. It is common in all parts of Vermont where often it is only a roadside shrub. The flowers appear in May on long pedicels in beautiful white clusters. The fruit, which ripens in midsummer, is small and globular, becoming bright red when mature. This tree is distinguished from the other cherries by its slender and more graceful form, by its lighter colored, close-growing bark, often covered with transverse scars (lenticels), by its small flowers in spreading clusters and by its very small globular fruit similarly clustered.

Wild Plum. Canada Plum



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Flowering branchlet, x ½.
5. Vertical section of flower, enlarged.
6. Fruiting branchlet, x ½.

ROSACEAE

Wild Plum. Canada Plum

Prunus nigra Ait. [Prunus americana, v. nigra Waugh]

HABIT.—A small tree 20-25 feet high and 5-8 inches in trunk diameter; usually divides 5-6 feet from the ground into a number of stout, upright branches, forming a narrow, rigid crown.

LEAVES.—Alternate, simple, 3-5 inches long and one-half as broad; oblong-ovate to obovate, abruptly acuminate at the apex; doubly crenate-serrate; thick and firm; glabrous, light green above, paler beneath; petioles short, stout, bearing 2 large red glands near the blade.

FLOWERS.—April-May, before the leaves; perfect; slightly fragrant; about 1 inch across; borne on slender, glabrous, red pedicels in 2-3-flowered umbels; calyx 5-lobed, dark red; petals 5, white; stamens 15-20, with purple anthers; ovary 1-celled; style 1; stigma 1.

FRUIT.—August-September; a fleshy drupe, about 1 inch long, oblong-ovoid, with a tough, thick, orange-red skin nearly free from bloom, and yellow flesh adherent to the flat stone. Eaten raw or cooked.

WINTER-BUDS.—Terminal bud absent; lateral buds ⅛-¼ inch long, ovate, acute, chestnut-brown.

BARK.—Twigs green, marked by numerous pale excrescences, later dark brown; thin, gray-brown and smooth on young trunks, but soon splitting off in large, thick plates, exposing the darker inner bark.

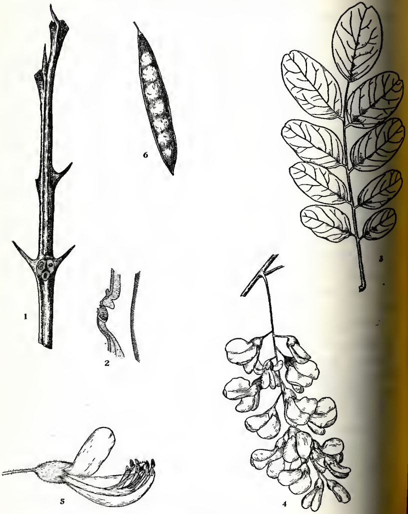
WOOD.—Heavy, hard, strong, close-grained, light red-brown, with thin, lighter colored sapwood.

DISTRIBUTION.—Frequent, especially in the northern portion of the state; never native in eastern Vermont.

HABITAT.—Woods; fence-rows.

NOTES.—The Canada plum, found frequently in Vermont, is a small tree or shrub, with gray-brown bark and short, spiny branchlets. It may be recognized by its broad, coarse leaves, sometimes four inches long and two or three inches wide. The flowers are abundant, large and strong, of a fine pinkish color, and appear about the first week in May. The fruit, often an inch in diameter, ripens in August. It is sometimes rather bitter, but occasional trees bear good eatable fruit.

Common Locust. False Acacia



(Mich. Trees).

1. Winter twig, x 1.
2. Vertical section through lateral bud, enlarged.
3. Leaf, x ½.
4. Raceme of flowers, x ½.
5. Flower, with part of corolla removed, enlarged.
6. Fruit, x ½.

LEGUMINOSAE

Common Locust. False Acacia

Robinia pseudo-acacia L.

HABIT.—A tree 50-75 feet high, with a trunk diameter of 2-3 feet; usually smaller; forming a narrow, oblong crown of irregular, more or less contorted branches.

LEAVES.—Alternate, compound, 8-14 inches long. Leaflets 7-21, short-petiolate, 1-2 inches long, about one-half as broad; ovate to oblong-oval; entire; very thin; dull dark green above, paler beneath, glabrous both sides. Petioles slender, pubescent.

FLOWERS.—June, after the leaves; perfect; showy and abundant; very fragrant; borne on slender pedicels in loose, drooping racemes 4-5 inches long; about 1 inch long; calyx short, bell-shaped, 5-lobed, hairy; corolla papilionaceous, white, 5-petaled; stamens 10.

FRUIT.—Late autumn, but persistent on the tree through the winter; a smooth, dark brown, flat pod 3-4 inches long, containing 4-8 small, flattish, brown seeds.

WINTER-BUDS.—Terminal bud absent; lateral buds minute, 3-4 superposed, partially sunken within the leaf-scar, rusty-hairy.

BARK.—Twigs smooth, green, more or less rough-dotted at first, becoming red-brown and armed with prickles; dark red-brown and thick on old trunk, deeply furrowed into firm, sinuous ridges. Plate VI.

WOOD.—Heavy, very strong and hard, close-grained, very durable in contact with the soil, brown, with very thin, pale yellow sapwood.

NOTES.—The common locust is a native of Pennsylvania and the more southern states. It has been widely planted in Vermont and frequently has run wild along fence-rows and about yards. The profusion of the fragrant, white, pea-like blossoms, the delicacy of the foliage and the picturesque form of the tree combine to make it very attractive. This locust is a large, rapidly growing tree, but it is attacked by borers and probably cannot be successfully grown in Vermont.

THE MAPLES

The maple family is a large one including nearly seventy species. Ten of these occur in the United States, and seven are found in Vermont. In many respects they form the most characteristic feature of our forest flora, and were Vermonters to select a state tree, popular choice certainly would be unanimous for the sugar maple.

The maples are distinguished easily from all other trees by their peculiar winged or "key" fruit. The leaves of all except the ash-leaved maple also are so similar as to form a good family character.

Two of the seven native species are as frequently shrubby as they are tree-like both in size and habit of growth, but all are included in this bulletin. By appealing to the size of the tree and characters of the leaves it is possible to distinguish the species.

Introduced species.—The Norway maple is a European species frequently used as a street shade tree farther south, and occasionally planted in Vermont. It most closely resembles the sugar maple among our native species but is easily distinguished by its broader and lower crown, larger leaves and larger, more divergent key-fruits.

Numerous horticultural varieties of the silver maple have been introduced in recent years, especially from Japan. These include very deeply cut-leaved forms, and also one with drooping branches. Their relationship to the native species is usually recognizable however.

The horse-chestnuts and buckeyes are closely related to the maples, although some authorities place them in a separate family. Of these the common horse-chestnut (*Aesculus hippocastanum*) is very commonly cultivated. It forms a large, clean, symmetrical tree, with rich foliage and showy blossoms. The buckeyes of the south and west are occasionally planted.

SUMMER KEY TO THE SPECIES OF ACER

a. Leaves simple; twigs usually without whitish bloom.

b. Leaf-sinuses acute at the base.

c. Leaf-lobes long and narrow, the sides of the terminal lobe diverging; leaves silvery white beneath; twigs rank-smelling when broken .... **A. saccharinum**, p. 173.

cc. Leaf-lobes short and broad, the sides of the terminal lobe converging; leaves not conspicuously white beneath; twigs not rank-smelling when broken.

d. Leaves distinctly white-downy beneath; twigs appressed-hairy, at least near the tip; fruit hanging in pendulous racemes, persistent on the tree until autumn; seed portion with pit-like depression on one side; usually a shrub or bushy tree .... **A. spicatum**, p. 167.

dd. Leaves glabrous or nearly so beneath; twigs glabrous; fruit hanging in clusters, falling in early summer; seed portion without pit-like depression on one side; medium-sized tree .... **A. rubrum**, p. 175.

bb. Leaf-sinuses rounded at the base.

c. Lower sides of leaves and petioles distinctly downy, the lobes undulate or entire; leaves very thick, drooping at the sides, **A. saccharum nigrum**, p. 171.

cc. Lower sides of leaves and petioles essentially glabrous, the lobes serrate; leaves not thick, not drooping at the sides.

d. Leaves coarsely and sparsely toothed or notched; bark not longitudinally white-striped; fruit not in racemose clusters; large tree .... **A. saccharum**, p. 169.

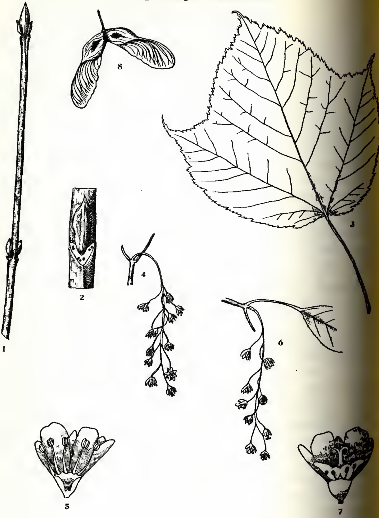
dd. Leaves finely and abundantly toothed; bark longitudinally white-striped; fruit in racemose clusters; a bushy tree or shrub .... **A. pennsylvanicum**, p. 165.

aa. Leaves compound; twigs usually with whitish bloom, **A. negundo**, p. 177.

WINTER KEY TO THE SPECIES OF ACER

- *a.* Terminal buds usually under ¼ inch in length, not conspicuously stalked; bark not longitudinally white-striped.
  - *b.* Buds white-woolly; twigs usually with a whitish bloom; opposite leaf-scars meeting; fruit often persistent on the tree until spring .... **A. negundo,** p. 177.
  - *bb.* Buds not white-woolly; twigs without whitish bloom; opposite leaf-scars not meeting; fruit not persistent on the tree in winter.
    - *c.* Buds reddish or greenish; twigs bright red.
      - *d.* Twigs strictly glabrous; buds glabrous; spherical flower buds clustered on the sides of the shoot; pith pink; large trees.
        - *e.* Twigs rank-smelling when broken; tip of outer bud-scales often apiculate; tips of branches curving upwards; bark separating into long, thin flakes loose at the ends, **A. saccharinum,** p. 173.
        - *ee.* Twigs not rank-smelling when broken; tip of outer bud-scales rounded; tips of branches not conspicuously curving upwards; bark rough-ridged, but seldom forming loose flakes .... **A. rubrum,** p. 175.
      - *dd.* Twigs appressed-hairy, at least near the tip; buds somewhat tomentose; spherical flower buds absent; pith brown; shrub or bushy tree...................... **A. spicatum,** p. 167.
    - *cc.* Buds brownish; twigs brownish or grayish.
      - *d.* Buds glabrous, or somewhat pubescent at the apex only; bark dark gray on the trunk....... **A. saccharum,** p. 169.
      - *dd.* Buds hoary-pubescent; bark sometimes almost black on the trunk .... **A. saccharum nigrum,** p. 171.
- *aa.* Terminal buds usually ¼-½ inch in length, conspicuously stalked; bark longitudinally white-striped... **A. pennsylvanicum,** p. 165.

Striped Maple. Moosewood



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Staminate flowering branchlet, x ½.
5. Vertical section of staminate flower, enlarged.
6. Pistillate flowering branchlet, x ½.
7. Vertical section of pistillate flower, enlarged.
8. Fruit, x ¾.

ACERACEAE

Striped Maple. Moosewood

Acer pennsylvanicum L.

HABIT.—A small tree at best, more often a large shrub, seldom attaining a height of more than 20 feet, with a short trunk 5-8 inches through. The striped, upright branches form a rather compact crown.

LEAVES.—Opposite, simple, 5-6 inches long and nearly as broad; 3-lobed above the middle with short, tapering lobes; palmately 3-nerved; sharply doubly serrate; rounded or heart-shaped at the base; glabrous, yellow-green above, paler beneath, turning pale yellow in autumn; petioles stout, grooved.

FLOWERS.—May-June, when the leaves are nearly full grown; usually monoecious; large bright yellow, bell-shaped, in slender, drooping racemes 4-6 inches long; calyx 5-parted; petals 5; stamens 7-8; ovary downy.

FRUIT.—Ripens in autumn; glabrous, paired samaras in long, drooping, racemose clusters, the wings ¾ inch long, widely divergent, and marked on one side of each nutlet by a small cavity.

WINTER-BUDS.—Bright red; terminal bud nearly ½ inch long, short-stalked, with bud-scales keeled; lateral buds smaller, appressed.

BARK.—Twigs light green, mottled with black, smooth; trunk and branches red-brown, marked longitudinally by broad, pale stripes.

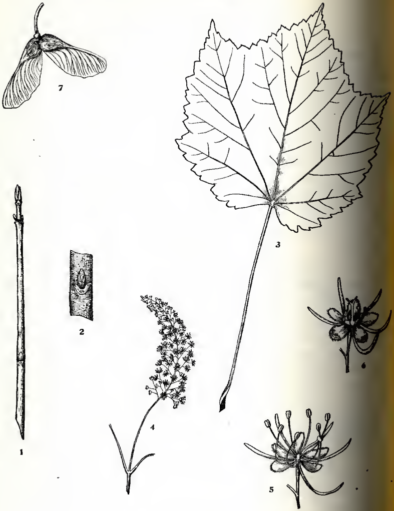
WOOD.—Light, soft, close-grained, pinkish brown, with thick, lighter colored sapwood.

DISTRIBUTION.—Common throughout Vermont.

HABITAT.—Cool, rocky or sandy woods, in rich soil, usually in the shade of other trees.

NOTES.—The striped maple is a small tree or shrub which forms a familiar part of the undergrowth of our forests, and is a common roadside bush in all parts of Vermont. It is easily distinguished by its greenish bark striped longitudinally with darker lines. The leaves, the largest of the maples, are usually from five to seven inches long and four or five inches wide. Its drooping clusters of greenish flowers unfold by the middle of June when the leaves are nearly grown. The fruits are abundant and turn a beautiful scarlet towards autumn. This maple rarely exceeds a height of twenty feet. It also has a distinct value for ornamental planting, especially in groups or borders.

Mountain Maple



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Fruit, x 1.

ACERACEAE

Mountain Maple

Acer spicatum Lam.

HABIT.—A bushy tree sometimes 20 feet high, with a short trunk 4-6 inches in diameter; small, upright branches form a small, rounded crown. More often a straggling shrub.

LEAVES.—Opposite, simple, 4-5 inches long and two-thirds as broad; 3-lobed above the middle, the lobes coarsely crenate-serrate with pointed teeth, the sinuses usually wide-angled and acute at the base; thin; glabrous, dark green above, covered with a whitish down beneath, turning scarlet and orange in autumn; veining prominent; petioles long, slender, with enlarged base.

FLOWERS.—May-June, after the leaves are full grown; polygamo-monoecious; small, yellow-green, in erect, slightly compound, many-flowered, long-stemmed, terminal racemes; calyx downy, 5-lobed; petals 5; stamens 7-8; ovary tomentose.

FRUIT.—July-August; bright red, turning brown in late autumn; small, glabrous, paired samaras, in pendulous, racemose clusters.

WINTER-BUDS.—Small, flattish, acute, bright red, more or less tomentose; the terminal ⅛ inch long, containing the flowers.

BARK.—Twigs reddish, slightly hairy; very thin, red-brown, smooth or slightly furrowed on the trunk.

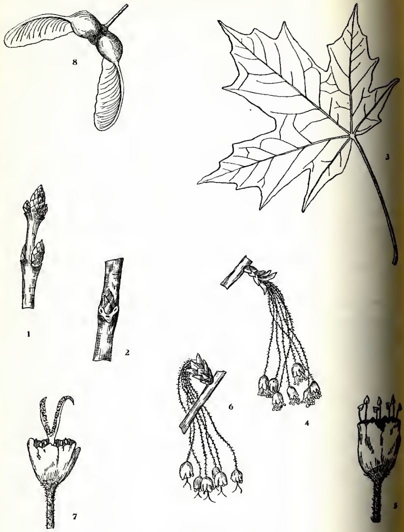
WOOD.—Light, soft, close-grained, light brown, with thick, lighter colored sapwood.

DISTRIBUTION.—Of common occurrence throughout Vermont.

HABITAT.—Damp mountain forests; rocky woods; along streams and roadsides; cool ravines; always in the shade of other trees.

NOTES.—The mountain maple rarely becomes more than a shrub in Vermont. It occurs commonly in moist, rocky, mountain forests in all parts of the state. Like the striped maple it is partial to roadsides, and borders all our mountain driveways. The leaves are thin and downy on the under side. The yellowish green flowers are borne in erect pubescent clusters which appear in the latter part of June. It is the spike-like arrangement of these flowers which suggested the Latin name of the species. The fruits are very divergent, smaller than those of any other maple and become bright red in July and August. The heavy clusters then hang down and turn dark brown before being scattered by the winds. This maple is one of the most highly ornamental of the smaller trees, and worthy of more general cultivation.

Sugar Maple



(Mich. Trees).

1. Winter twig, x 2.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Staminate flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flowering branchlet, x ½.
7. Pistillate flower, enlarged.
8. Fruit, x 1.

ACERACEAE

Sugar Maple. Rock Maple

Acer saccharum Marsh. [Acer saccharinum Wang.]

Habit.—A stately tree 60-100 feet in height, with a trunk diameter of 3-4 feet; in the open forming stout, upright branches near the ground, in forests making remarkably clean trunks to a good height; the crown is a broad, round-topped dome.

Leaves.—Opposite, simple, 3-5 inches long and broad; usually 5-lobed (sometimes 3-lobed), the lobes sparingly wavy-toothed, the sinuses broad and rounded at the base; thin and firm; opaque, dark green above, lighter and glabrous beneath, turning yellow and red in autumn; petioles long, slender.

Flowers.—April-May, with the leaves; polygamo-monoecious or dioecious; on thread-like, hairy pedicels in nearly sessile corymbs; greenish yellow; calyx campanulate, 5-lobed; corolla 0; stamens 7-8; ovary hairy.

Fruit.—September-October, germinating the following spring; paired samaras, glabrous, with wings about 1 inch long, diverging slightly.

Winter-buds.—Small, acute, red-brown, glabrous or somewhat pubescent toward the apex, the terminal ¼ inch long, the lateral smaller, appressed.

Bark.—Twigs smooth, pale brown, becoming gray and smooth on the branches; old trunks dark gray, deeply furrowed, often cleaving up at one edge in long, thick plates. Plate VII.

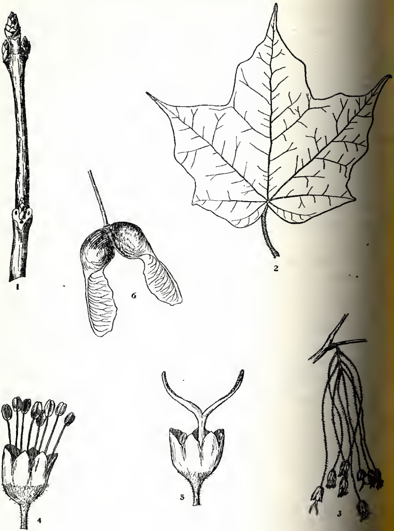
Wood.—Heavy, hard, strong, close-grained, tough, durable, light brown, with thin, lighter colored sapwood. Page 223.

Distribution.—Found throughout Vermont.

Habitat.—Prefers moist, rich soil in valleys and uplands and moist, rocky slopes.

Notes.—The sugar maple is everywhere in Vermont, but it thrives best on the cool and rocky uplands. It can be distinguished by its light gray bark which has large, white patches on the younger branches or by its broad, five-lobed leaves which have shallow, rounded, sinuses. In the sugar-bushes of Vermont, trees three and four centuries old not infrequently are found. Besides its value as a sugar tree, its timber is hard and durable. The "curled" and "bird's-eye" maple are unusual forms of this species, produced by a peculiar curling of the fibers.

Black Sugar Maple



(Mich. Trees).

1. Winter twig, x 2.
2. Leaf, x ½.
3. Flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flower, enlarged.
6. Fruit, x 1.

ACERACEAE

Black Sugar Maple

Acer saccharum nigrum (Michx. f.) Britt. [Acer nigrum Michx.]

HABIT.—A stately tree, sometimes reaching a height of 80 feet, with a trunk diameter of 2-3 feet; branches stout, forming a broad, rounded, symmetrical crown.

LEAVES.—Opposite, simple, concave, 5-7 inches across, the breadth usually exceeding the length; usually 5-lobed at maturity, the two lower lobes being small, often reduced to a mere curve in the outline, the pointed lobes undulate or entire and narrowed from the broad, shallow sinuses; thick and firm; glabrous above, downy beneath; petioles stout, usually pendent, tomentose. The sides of the larger leaves often droop giving to the tree an air of depression.

FLOWERS.—May, with the leaves; monoecious; in nearly sessile, umbel-like corymbs; about ¼ inch long, yellow, on slender, hairy pedicels 2-3 inches long; calyx campanulate, pilose, 5-lobed; corolla 0; stamens 7-8; ovary hairy.

FRUIT.—Ripens in autumn; glabrous, paired samaras, clustered on drooping pedicels; wings set wide apart, but only slightly diverging.

WINTER-BUDS.—Small, ovoid, acute, with dark red-brown, acute scales, hoary-pubescent on the outer surface.

BARK.—Twigs smooth, pale gray; becoming thick, deeply furrowed and sometimes almost black on the trunk.

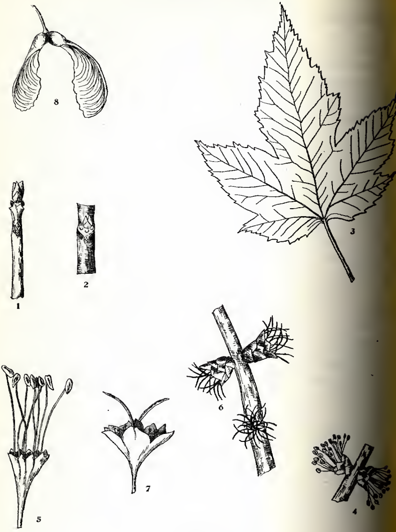
WOOD.—Hard, heavy, strong, close-grained, creamy white, with thin, lighter colored sapwood.

DISTRIBUTION.—Lake Champlain valley. Occasional.

HABITAT.—Low, moist, rich soil of river-bottoms.

NOTES.—This tree has long been a puzzle to botanists. In leaf characters it differs considerably from the sugar maple, but resembles it in fruit characters, general habit and in sugar production. As indicated in the key, the leaf is less deeply lobed, and is minutely hairy on the lower face; it may be hairy also along the leaf stalk. It is thicker and more leathery in texture and usually is heart-shape at the base, the rounded basal lobes sometimes overlapping. This black sugar maple should not be confused with specimens of the ordinary sugar maple having darker bark. Sugar-makers often term such trees "black maples." The bark of this black sugar maple generally is dark, but the leaf characters must be appealed to in its recognition.

White Maple. Silver Maple



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Staminate flowering branchlet, x 1.
5. Staminate flower, enlarged.
6. Pistillate flowering branchlet, x 1.
7. Pistillate flower, enlarged.
8. Fruit, x ½.

ACERACEAE

White Maple. Silver Maple

Acer saccharinum L. [Acer dasycarpum Ehrh.]

HABIT.—A beautiful tree, growing to a height of 60-80 feet, with a trunk diameter of 2-4 feet, usually separating near the ground into 3-4 upright stems which are destitute of branches for a considerable distance. Usually the long, slender branches bend downwards, but with their tips ascending in a graceful curve. Crown broad, especially in its upper portion.

LEAVES.—Opposite, simple, 3-6 inches long and nearly as broad; usually 5-lobed by narrow, acute sinuses which extend nearly to the midrib, the lobes often sublobed, sharply toothed; light green above, silvery white beneath, turning pale yellow in autumn; petioles long, slender, drooping.

FLOWERS.—April-May, before the leaves; polygamo-monoecious or dioecious; small, yellow-green, in crowded, sessile umbels; calyx 5-lobed (sometimes each lobe again divided); corolla 0; stamens 3-7; ovary hairy.

FRUIT.—May, germinating as soon as it reaches the ground; paired samaras, large, glabrous, curving inwards, one samara often aborted.

WINTER-BUDS.—Dark red, blunt; the terminal about ¼ inch long, with bud-scales often apiculate; flower-buds clustered on side spurs.

BARK.—Twigs smooth, red-gray, lustrous; young trunks gray, smooth; old trunks dark gray, more or less furrowed, separating into thin, loose scales. Plate VII.

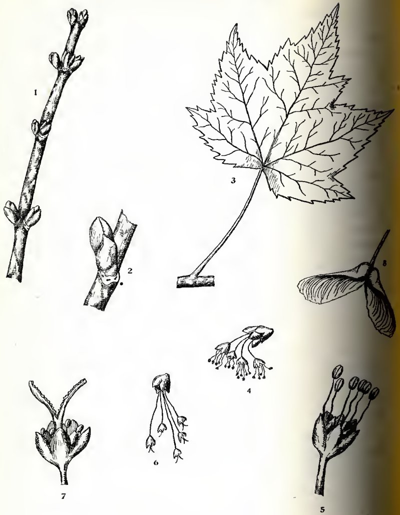
WOOD.—Hard, strong, close-grained, rather brittle, perishable, pale brown, with thick, lighter colored sapwood.

DISTRIBUTION.—Frequent throughout Vermont, especially near the shores of Lake Champlain and tributary streams.

HABITAT.—Prefers low, rich bottom-lands, subject to occasional inundation, but not in swamps; banks of rivers and lakes at low altitudes.

NOTES.—The silver maple is a large, graceful tree, generally distributed along our water courses, especially near the shores of Lake Champlain and the streams emptying into it. It resembles the red maple but is distinguished from it by its longer, more deeply cut, lighter green leaves which are silvery white on the lower side. Although the silver maple flourishes best in moist soil, it will make vigorous growth and become a beautiful shade tree in dry locations.

Red Maple. Swamp Maple



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x 1.
4. Fascicle of staminate flowers, x 1.
5. Staminate flower, enlarged.
6. Fascicle of pistillate flowers, x 1.
7. Pistillate flower, enlarged.
8. Fruit, x ¾.

ACERACEAE

Red Maple. Swamp Maple

Acer rubrum L.

HABIT.—A medium-sized tree 40-50 feet high, occasionally in swamps 60-75 feet; trunks 1-3 feet in diameter; upright branches, which form a low, rather narrow, rounded crown.

LEAVES.—Opposite, simple, 3-4 inches long and nearly as broad; 3-5-lobed by broad, acute sinuses, the lobes irregularly doubly serrate or toothed; glabrous, green above, whitish and generally glabrous beneath, turning bright scarlet in autumn; petioles long, slender.

FLOWERS.—April-May, before the leaves; polygamo-monoecious or dioecious; in few-flowered fascicles on shoots of the previous year, the pistillate red, the staminate orange; sepals 4-5; petals 4-5; stamens 5-8; ovary smooth.

FRUIT.—May-June, germinating immediately after reaching the ground; samaras small, on drooping pedicels 2-4 inches long; wings about 1 inch long, diverging at about a right angle.

WINTER-BUDS.—Dark red, blunt; terminal bud about ⅛ inch long, with bud-scales rounded at the apex; flower-buds clustered on side spurs.

BARK.—Twigs bright red, lustrous, becoming smooth and light gray on the branches; old trunks dark gray, ridged, separating into plate-like scales. Plate VII.

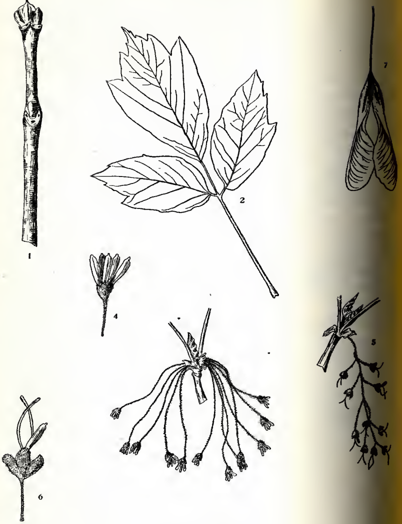
WOOD.—Heavy, close-grained, not strong, light brown, with thick, lighter colored sapwood.

DISTRIBUTION.—Common throughout Vermont.

HABITAT.—Prefers swamp-lands or banks of streams; moist woods.

NOTES.—The scarlet flowers of this maple give us the brightest spring welcome from the trees. When the red maple is a blaze of color and the other trees are still bare and brown, it is conspicuous and unmistakable, and in autumn the rich coloring of its leaves makes it conspicuous again. The leaves of the silver maple turn yellow and those of the sugar maple yellow or red, but not the crimson or deep red of the red maple. It is distinguished from the sugar maple by its smoother, dark gray bark and by the deeper acute incisions of the leaves although they are subject to much variation. The fruit is about one inch long and like that of silver maple falls in early summer. This tree, common throughout the eastern United States, is very generally distributed in Vermont.

Box Elder



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ½.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flowering branchlet, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x 1.

ACERACEAE

Box Elder

Acer negundo L. [Negundo aceroides Moench.]

HABIT.—A sturdy little tree 30-40 feet high, with a trunk diameter of 1-2 feet. Trunk often divides near the ground into several stout, wide-spreading branches, forming a broad, unsymmetrical, open crown.

LEAVES.—Opposite, pinnately compound. Leaflets 3-5 in number, 2-4 inches long, 1½-2½ inches broad; ovate or oval; nearly entire, irregularly and remotely coarse-toothed above the middle, or sometimes 3-lobed (often giving the leaflet a jagged outline); apex acute, base variable; glabrous or somewhat pubescent at maturity, with prominent veins. Petioles slender, 2-3 inches long, the enlarged base leaving prominent crescent-shaped scars partly surrounding the winter-buds.

FLOWERS.—April-May, before or with the leaves; dioecious; small, yellow-green; the staminate in clusters on long, thread-like, hairy pedicels; the pistillate in narrow, drooping racemes; calyx hairy, 5-lobed; corolla 0; stamens 4-6; ovary pubescent.

FRUIT.—Early summer, but hanging until late autumn or early spring; narrow, flat, winged samaras, in pairs, clustered in drooping, racemose clusters.

WINTER-BUDS.—Terminal bud ⅛-¼ inch long, acute, inclosed in two dull red scales, often hoary or minutely pubescent; lateral buds obtuse, appressed.

BARK.—Twigs greenish to purple, glaucous; trunk pale gray or light brown, deeply cleft into broad ridges.

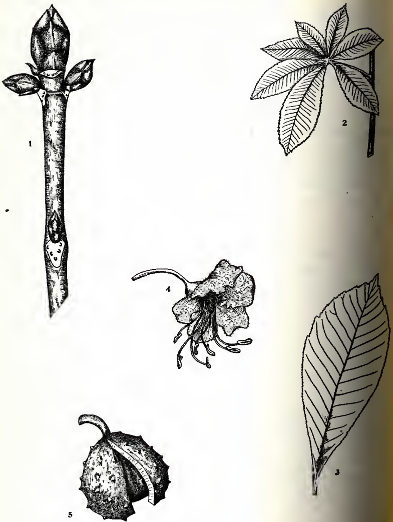
WOOD.—Light, soft, close-grained, weak, creamy white, with thick, hardly distinguishable sapwood.

DISTRIBUTION.—From the Winooski river southward, in some places locally abundant; occurs sparingly along streams in the Champlain valley.

HABITAT.—Banks of streams and borders of swamps. Prefers deep, moist soil.

NOTES.—The box elder accommodates itself to almost any situation. It is easily transplanted and grows rapidly. For these reasons it is sometimes planted for shade and ornament, but it is not a desirable tree for this purpose.

Common Horse-chestnut



(Mich. Trees).

1. Winter twig, x ¾.
2. Leaf, x ⅙.
3. Leaflet, x ½.
4. Flower, x 1.
5. Fruit, x ½.

SAPINDACEAE

Common Horse-chestnut

Aesculus hippocastanum L.

HABIT.—A handsome tree, with a height of 40-60 feet and a trunk diameter of 1-2 feet, forming a broad, conical crown. The regularly occurring branches ascend from the trunk at first, gradually bend downwards as they lengthen, and end in a thick, upturning spray.

LEAVES.—Opposite, digitately compound. Leaflets usually 7, rarely 5, 5-7 inches long, 1½-2½ inches broad; obovate, wedge-shaped at the base; irregularly and bluntly serrate; thick; rough, dark green above, paler beneath, turning a rusty yellow in autumn. Petioles long, grooved, swollen at the base.

FLOWERS.—May-June, after the leaves; polygamo-monoecious; large, whitish, in showy, upright, terminal thyrses 8-12 inches long; pedicels jointed, 4-6-flowered; calyx campanulate, 5-lobed; petals 5, white, spotted with yellow and red, clawed; stamens 7, thread-like, longer than the petals.

FRUIT.—October; a leathery, globular capsule about 2 inches in diameter, roughened with short spines; containing 1-3 large, smooth, lustrous, brown nuts, marked by large, pale scars.

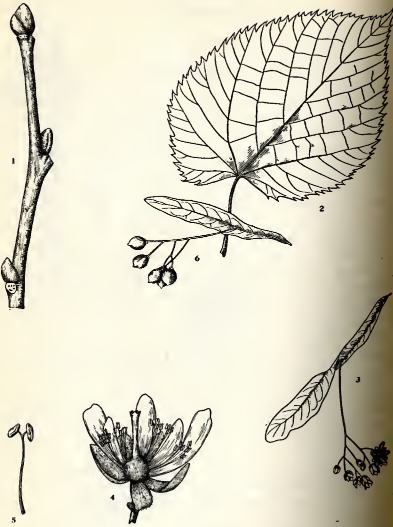
WINTER-BUDS.—Terminal buds 1-1½ inches long, acute, brownish, covered with glistening, resinous gum; inner scales yellowish, becoming 1½-2 inches long in spring, remaining until the leaves are nearly half grown.

BARK.—Twigs smooth, red-brown; trunk dark brown and broken into thin plates by shallow fissures; rich in tannin, bitter.

WOOD.—Light, soft, close-grained, weak, whitish, with thin, light brown sapwood.

NOTES.—The horse-chestnut is a native of Greece, but it is extensively cultivated throughout Europe and America, where it is favorite shade tree. A double-flowered variety, *Aesculus hippocastanum, v. flòre plèno*, which bears no fruit is a common garden form.

Basswood



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ½.
3. Cyme of flowers, with its bract, x ½.
4. Flower, with two petals, petaloid scales and stamens removed, enlarged.
5. Stamen, enlarged.
6. Fruit, x ½.

TILIACEAE

Basswood

Tilia americana L.

HABIT.—A tree usually 60-70 feet high, with a tall, straight trunk 2-4 feet in diameter; numerous slender branches form a dense, ovoid or rounded crown.

LEAVES.—Alternate, simple, 5-6 inches long, 3-4 inches broad; obliquely heart-shaped; coarsely serrate; thick and firm; glabrous, dull dark green above, paler beneath; petioles slender, 1-2 inches long.

FLOWERS.—June-July, after the leaves; perfect, regular; yellowish white, downy, fragrant; borne on slender pedicels in loose, drooping cymes, the peduncle attached for half its length to a narrow, oblong, yellowish bract; sepals 5, downy; petals 5, creamy white; stamens numerous, in 5 clusters; ovary 5-celled; stigma 5-lobed.

FRUIT.—October; globose, nut-like, woody, gray, tomentose, about the size of peas.

WINTER-BUDS.—Terminal bud absent; lateral buds ovoid, acute, often lopsided, smooth, dark red, ¼ inch long.

BARK.—Twigs smooth, reddish gray, becoming dark gray or brown; dark gray and smooth on young stems, on old trunks thick, deeply furrowed into broad, scaly ridges. Plate VII.

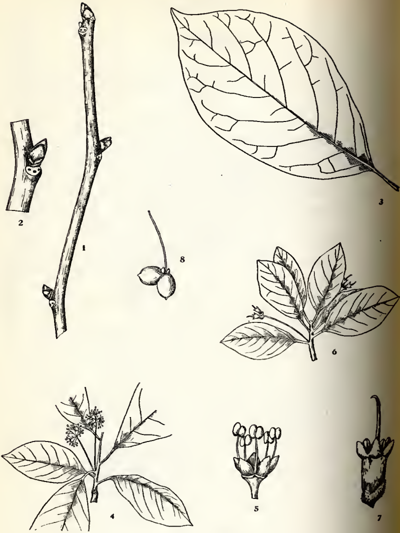
WOOD.—Light, soft, close-grained, tough, light red-brown, with thick sapwood of nearly the same color. Page 231.

DISTRIBUTION.—Common throughout Vermont at altitudes less than 1,000 feet, rare from 1,000-2,000 feet.

HABITAT.—Prefers rich, well-drained, loamy soils.

NOTES.—The basswood is a widely scattered tree in Vermont, growing with the maples, oaks and elms. Its leaves are five or six inches long and nearly as wide, with a base more deeply cordate on one side than the other. The flowers, which open in July, are creamy-white, borne in clusters suspended from a tongue-like leaf or bract. They are very fragrant and so full of nectar that the basswood often is called the bee-tree. The fruit ripens in autumn, forming hard brown balls or nutlets the size of peas. Basswood lumber is brownish or nearly white, light but rather tough, and is extensively used for drawers and similar cabinet work, panels, inside wood-work and for toys. Owing to the fact that it is bent readily, it is used for the bodies and dash boards of carriages and sleighs. The European linden (*T. europea*) occasionally is cultivated. It closely resembles the American species.

Black Gum. Tupelo



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ¾.
4. Staminate flowering branchlet, x ½.
5. Staminate flower, enlarged.
6. Pistillate flowering branchlet, x ½.
7. Pistillate flower, enlarged.
8. Fruit, x ½.

CORNACEAE

Black Gum. Tupelo

Nyssa sylvatica Marsh. [Nyssa multiflora Wang.]

HABIT.—A medium-sized tree 20-40 feet high, with a trunk diameter of 1-2 feet, forming a rounded to cylindrical crown of slender, spreading, pendulous branches and a stiff, flat spray.

LEAVES.—Alternate, simple, 2-5 inches long, one-half as broad; oblong-obovate to oval; entire, or sometimes wavy-margined; thick and firm; very lustrous and dark green above, pale and often hairy beneath, turning bright scarlet, on the upper surface only, in autumn; petioles short.

FLOWERS.—May-June, with the leaves; polygamo-dioecious; greenish; borne on slender, downy peduncles; the staminate slender-pedicelled, in many-flowered heads; the pistillate sessile, in several-flowered clusters; calyx cup-shaped, 5-toothed; petals 5; stamens 5-10; stigma stout, terete, recurved.

FRUIT.—October; fleshy drupes, ovoid, blue-black, about ½ inch long, sour, in clusters of 1-3.

WINTER-BUDS.—⅛-¼ inch long, ovoid, obtuse, dark red.

BARK.—Twigs greenish or light brown, smooth or often downy, becoming smooth, dark red-brown; thick, red-brown on old trunks, deeply furrowed. Plate VIII.

WOOD.—Heavy, soft, strong, very tough, difficult to split, not durable in contact with the soil, pale yellow, with thick, whitish sapwood.

DISTRIBUTION.—Occasional along the shores of Lake Champlain and in the adjacent river-bottoms; also in southwestern Vermont; has been found in central Vermont as far north as Craftsbury.

HABITAT.—Prefers the borders of swamps and low, wet lands. Rarely flourishes in exposed situations.

NOTES.—The sour gum has a peculiar appearance with horizontal branches and smooth or glossy leaves, borne in beech-like sprays. Its greenish flowers appear in June and are followed by the dark-blue, egg-shaped fruits, one-half of an inch long, with thin, acid flesh, ripening in October. It is of great ornamental value when planted within its range.

THE ASHES

The olive family takes its name from the olive tree of Asia. The only representatives among our native trees are the ashes; but several of the commonly planted ornamental shrubs, the lilacs and other syringas and the beautiful forsythia, belong to this family.

The individual flowers of the ashes are small; but coming as they do before the leaves and appearing in crowded clusters, they are quite conspicuous. The flowers are of two kinds, the pollen producing and the seed bearing being on separate trees. The ashes, like the maples, have prominently winged fruit, but those of the ash hang singly whereas the maple "keys" are always in pairs.

The ashes are among the most useful of the hardwood forest trees of America, yielding to the oaks alone in value. Two species, the black ash and the white ash, occur commonly throughout Vermont, the red ash and the green ash are restricted or local in their distribution. The latter two are very similar and intermediate forms connect them so closely that some authorities rate the green ash as but a variety of the red ash. In using the following key it is to be observed that the ash leaf is compound, that is, each leaf is divided into from seven to eleven smaller leaflets, as will be seen by examining any of the figures.

SUMMER KEY TO THE SPECIES OF FRAXINUS

a. Lateral leaflets sessile .... **F. nigra,** p. 193.

aa. Lateral leaflets petioled.

- *b*. Twigs, petioles and lower sides of leaves pubescent, **F. pennsylvanica,** p. 189.
- *bb*. Twigs, petioles and lower sides of leaves essentially glabrous.
  - *c*. Lower sides of leaves essentially of the same color as the upper; leaflet-margins rather finely sharp-serrate, **F. pennsylvanica lanceolata,** p. 191.
  - *cc*. Lower sides of leaves paler than the upper; leaflet-margins entire or obscurely serrate .... **F. americana,** p. 187.

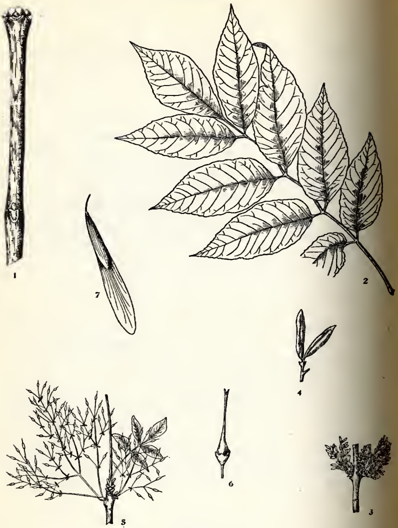
WINTER KEY TO THE SPECIES OF FRAXINUS

a. Buds rusty-tomentose; twigs more or less downy, **F. pennsylvanica,** p. 189

aa. Buds not tomentose; twigs not downy.

- *b*. Terminal bud black or nearly so, showing 3 pairs of scales in cross-section; bud-scales apiculate at the apex; samaras with broad wings, the seed portion flattish; bark flaky, rubbing off on the hand .... **F. nigra,** p. 193.
- *bb*. Terminal bud brownish, showing 4 pairs of scales in cross-section; bud-scales rounded at the apex; samaras with narrow wings, the seed portion terete; bark ridged, not flaky and rubbing off on the hand.
  - *c*. Upper margin of leaf-scars deeply concave, **F. americana,** p. 187.
  - *cc*. Upper margin of leaf-scars not concave, but straight across or projecting upward..... **F. pennsylvanica lanceolata,** p. 191.

White Ash



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ¼.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flowering branchlet, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x 1.

OLEACEAE

White Ash

Fraxinus americana L.

HABIT.—A large tree 50-75 feet high, with a trunk diameter of 2-3 feet; forming an open, pyramidal crown of long, slender, lateral branches and a stout, rather sparse spray.

LEAVES.—Opposite, pinnately compound, 8-12 inches long. Leaflets usually 7-9, 3-5 inches long, 1-2 inches broad; short-stalked; ovate to oblong-lanceolate; entire or obscurely serrate; thick and firm; glabrous, dark green above, paler beneath. Petioles glabrous, stout, grooved.

FLOWERS.—May, before the leaves; dioecious; borne in loose panicles on shoots of the previous season; calyx campanulate, 4-lobed; corolla 0; stamens 2, rarely 3; ovary 2-celled.

FRUIT.—August-September, persistent on the branches until midwinter or the following spring; samaras 1-2 inches long, in crowded, drooping, paniculate clusters 6-8 inches long.

WINTER-BUDS.—Short, rather obtuse; bud-scales apiculate, keeled, 4 pairs, rusty-brown.

BARK.—Twigs at first dark green, becoming gray or light brown, often covered with a glaucous bloom; gray, deeply furrowed into firm, narrow, flattened ridges on the trunk. Plate VIII.

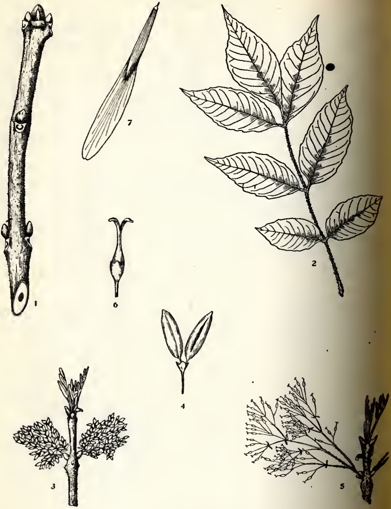
WOOD.—Heavy, hard, strong, close-grained, tough, brown, with thick, lighter colored sapwood. Page 225.

DISTRIBUTION.—Of common occurrence throughout Vermont.

HABITAT.—Prefers a rich, moist, loamy soil, but grows in any well-drained situation; common along stream-beds.

NOTES.—The white ash occurs in all parts of Vermont and upon all kinds of soil, but it prefers a rich, moist location. It is an open spreading tree in the field but in the forest it sends up a clean, straight shaft with a very small head. This character helps to make the white ash one of the valuable timber trees of our forests. The wood is strong, tough, elastic, durable and easily worked. It is manufactured into casings, every kind of furniture, agricultural implements and parts of carriages. It is said that in strength and elasticity the white ash timber from Vermont is superior to that from most other sources. The white oak and the hickories are the only native trees which have a higher value for fuel. This ash is recognized by its compound leaves, nearly twelve inches long, with from seven to nine smooth, petioled leaflets.

Red Ash



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ⅓.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flowering branchlet, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x 1.

OLEACEAE

Red Ash

Fraxinus pennsylvanica Marsh. [Fraxinus pubescens Lam.]

HABIT.—A medium-sized tree 30-50 feet high, with a trunk diameter of 1-2 feet; stout, upright branches and slender branchlets form a compact, broad, irregular crown.

LEAVES.—Opposite, pinnately compound, 10-12 inches long. Leaflets 7-9, 3-5 inches long, 1-1½ inches broad; short-stalked; oblong-lanceolate to ovate; slightly serrate or entire; thin and firm; glabrous, yellow-green above, pale and silky-downy beneath. Petioles stout, pubescent.

FLOWERS.—May, with the leaves; dioecious; borne in compact, downy panicles on shoots of the previous season; calyx cup-shaped, 4-toothed; corolla 0; stamens 2, rarely 3; ovary 2-celled.

FRUIT.—Early autumn, persistent on the branches throughout the winter; samaras 1-2 inches long, in open, paniculate clusters.

WINTER-BUDS.—Small, rounded; bud-scales rounded on the back, 3 pairs, rusty brown, tomentose.

BARK.—Twigs pale pubescent at first, lasting 2-3 years or often disappearing during the first summer, finally ashy gray or brownish and often covered with a glaucous bloom; brown or dark gray on the trunk, with many longitudinal, shallow furrows; somewhat scaly.

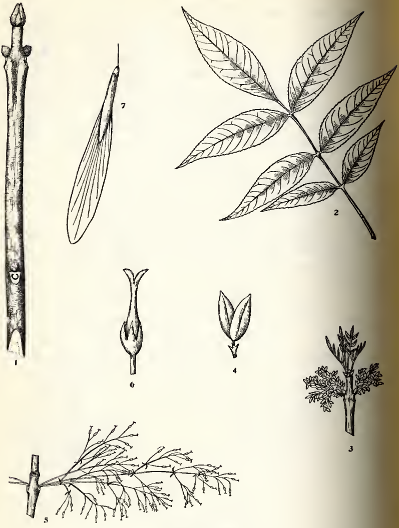
WOOD.—Heavy, hard, strong, brittle, coarse-grained, light brown, with thick, yellow-streaked sapwood.

DISTRIBUTION.—Common along Lake Champlain and its tributaries; occasional in other sections.

HABITAT.—Wet or moist, rich loam; river-banks; swampy lowlands.

NOTES.—The red ash closely resembles the white ash in general appearance. It may be recognized always, however, by looking closely at the buds in winter or at the young shoots or petioles in summer. These parts are velvety with delicate hairs, and it is this characteristic pubescence which suggested the Latin name of the species. The flowers and fruits bear a general resemblance to those of the white ash. The red ash is used considerably in manufactures but is inferior to the preceding species for most purposes. It is distributed generally along the shores of Lake Champlain and its adjacent waters but has not been reported from other parts of Vermont.

Green Ash



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ⅓.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flowering branchlet, x ½.
6. Pistillate flower, enlarged.
7. Fruit, x 1.

OLEACEAE

Green Ash

Fraxinus pennsylvanica lanceolata (Borkh.) Sarg. [Fraxinus lanceolata Borkh.] [Fraxinus viridis Michx. f.]

Considered by some authors to be a distinct species, and by others a variety of *F. pennsylvanica Marsh.*, which it resembles. The main points of difference are:

The usual absence of pubescence from the branchlets, the under side of the leaflets, and the petioles.

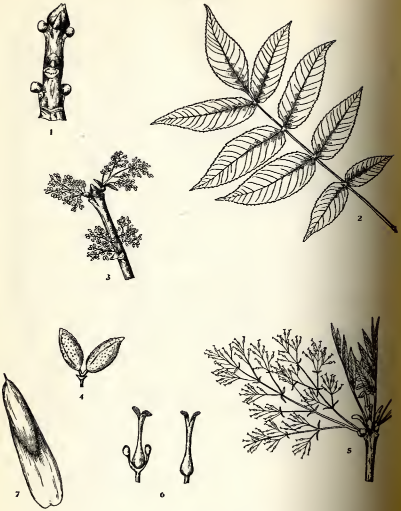
The rather narrower, shorter, and more sharply serrate leaflets.

The color of the leaves, which is bright green on both sides.

A very hardy tree, of rapid growth and desirable habit, making it useful for ornamental and street planting. Easily transplanted.

The green ash occurs occasionally along the shores of Lake Champlain.

Black Ash



(Mich. Trees).

1. Winter twig, x 1.
2. Leaf, x ⅓.
3. Staminate flowering branchlet, x ½.
4. Staminate flower, enlarged.
5. Pistillate flowering branchlet, x ½.
6. Pistillate flowers, enlarged.
7. Fruit, x 1.

OLEACEAE

Black Ash

Fraxinus nigra Marsh. [Fraxinus sambucifolia Lam.]

HABIT.—A tall tree 60-80 feet high, with a trunk diameter of 1-2 feet; slender, upright branches form in the forest a narrow crown, in the open a rounded, ovoid crown.

LEAVES.—Opposite, pinnately compound, 12-16 inches long. Leaflets 7-11, 3-5 inches long, 1-2 inches broad; sessile, except the terminal; oblong to oblong-lanceolate, long-pointed; remotely, but sharply serrate; thin and firm; dark green above, paler beneath, glabrous. Petioles stout, grooved, glabrous.

FLOWERS.—May, before the leaves; polygamo-dioecious; borne in loose panicles on shoots of the preceding season; calyx 0; corolla 0; stamens 2; ovary 2-celled.

FRUIT.—August-September, falling early, or sometimes hanging on the tree until the following spring; samaras 1-1½ inches long, in open, paniculate clusters 8-10 inches long.

WINTER-BUDS.—Ovoid, pointed; bud-scales rounded on the back, 3 pairs, almost black.

BARK.—Twigs at first dark green, becoming ashy gray or orange, finally dark gray and warted; thin, soft ash-gray and scaly on the trunk. Bark flakes off on rubbing with the hand. Plate VIII.

WOOD.—Heavy, tough, coarse-grained, weak, rather soft, dark brown, with thin, lighter colored sapwood.

DISTRIBUTION.—Common throughout the lower altitudes.

HABITAT.—Deep, cold swamps and low river-banks; wet woods.

NOTES.—The black ash is found in lowlands and swamps. Often it is called the brown ash but this name is confusing as it is applied also to the red ash. This and the white ash are the commoner species of Vermont. They are distinguished easily by the fact that the leaflets of the white ash always are distinctly stalked while the black ash has sessile leaflets. These are seven to eleven in number, often forming a leaf twelve to sixteen inches long which is smooth and green on both sides. Black ash timber is coarser-grained than is that of white ash. It is used for furniture and interior finishings and in the manufacture of baskets.

THE STRUCTURE AND IDENTIFICATION OF OUR COMMON LUMBER WOODS

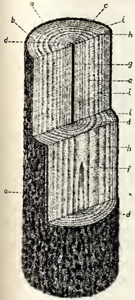
By C. H. OTIS

Common as wood is in its varied forms and uses, comparatively few people are able to distinguish our familiar trees when sawed into lumber and fashioned into houses, furniture and other manufactured products. Yet each wood has characteristics of color, odor, graining, weight, hardness, strength and minute structure peculiar to itself which distinguish it from other woods.

The value of each kind of wood for building purposes and every other use is determined to a large extent by its characteristics. These, taken in connection with the available supply of any particular timber in the country, govern the value or cost of that timber in the lumber market. So certain trees, like oak and cedar, because of their durability in contact with the soil, make admirable fence posts; spruce and the broad-leaved white birch and cottonwood possess structural qualities adapting them to the manufacture of paper pulp; hickory, very strong, tough and straight-grained, has long been valued for carriage and wagon stock and tool handles. Many examples might here be cited to show how various woods are peculiarly adapted to certain uses to a greater extent than are others. Again, some species, on account of our wasteful methods of lumbering, failure to provide means of reproduction and lack of restriction as to particular uses, have become so scarce that substitutes are offered in the markets to take their places. To such an extent has this become true that methods are in use to imitate the grain and color of some of the more depleted but valuable woods. Thus birch enters very largely into the composition of a great deal of so-called modern mahogany furniture, and cheap woods are often grained to imitate quarter-sawed white oak.

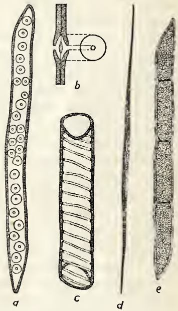
With the great variety of useful woods to be found in any lumber yard, it is important that consumers of wood in any form should be able to identify the different kinds offered so that they may choose those woods best suited to their particular needs and that they may obtain them and not lumber similar in appearance but otherwise of inferior qualifications.

Wood structure and the arrangement of the elements making up the woody tissues constitute the basis of the identification and use of timber. By structure is meant the relative size, shape and form of the wood elements peculiar to each tree. It is by reason of their structure that some woods are heavier, stronger and stiffer than others, that some are straight- and others are cross-grained, that some are hard and some soft and that some season rapidly and without injury while others have a tendency to check and split. The wide medullary rays of the oak explain the pleasing effect of the wood when quarter-sawed and polished to bring out the grain. The peculiar undulations of the growth rings sometimes found in the maple produce the "bird's-eye" markings which make the lumber so prized in the manufacture of furniture. It is our purpose to consider briefly the structure of a tree trunk and the various elements of the woody tissues.



VIII. LOG CUT TO SHOW FEATURES.

a. Bark.
b. Sapwood.
c. Heartwood.
d. Cross-section.
e. Radial-section.
f. Tangential-section.
g. Pith.
h. Growth ring.
i. Medullary ray.



IX. TYPICAL WOOD ELEMENTS, DIAGRAMMATIC. GREATLY ENLARGED.

a. Tracheid, showing bordered pits.
b. Scheme of bordered pit in section and surface views.
c. Segment or single cells of a vessel, showing spiral thickenings.
d. Wood or bast fiber.
e. Group of wood-parenchyma cells.

If we should go into a forest where felling operations are in progress or into a sawmill where there are unsawed logs, we would have an opportunity to examine the smooth-cut end of a mature log. We would note that it exhibits several well-defined areas or layers.

The first layer on the outside is probably rough externally and dark-colored. This is the bark, (a, fig. VIII), a protective covering to the inner woody tissues. The outer portion of the bark of a forest tree is dead tissue which is stretched and fissured as the tree grows in diameter, while the inner portion is live tissue, serving to conduct food materials up and down the trunk. In some kinds of trees the bark is quite thick, in others very thin. This factor, together with those of color and external appearance, makes the bark, when present, of considerable value in the determination of woods. At the center of the log is a small cylinder of loose tissue less than one-fourth of an inch in diameter, the pith (g, fig. VIII). Lying between the bark and the pith is the wood. In some kinds of trees, like the balsam fir and the hemlock, the wood is all of one color. In others, it consists of two parts distinct from each other in color. The outer portion is called sapwood (b, fig. VIII). It is living tissue and serves chiefly in the living tree to conduct the sap, or water which is taken up by the roots, to the leaves. The width of the sapwood varies with different species and with different individuals of the same species. In very young trees all the wood is sapwood. As the sapwood grows older, the tissue composing it becomes choked so as to prevent the further passage of sap. This tissue then dies and serves only as a support to the rest of the tree, holding up its great weight and making it rigid enough to resist strong winds. It usually becomes darker colored than the sapwood, and is called heartwood (c, fig. VIII). The sapwood and heartwood differ not only in color, but also in durability. In some species only the heartwood is suitable for sawing into lumber, being, as a rule, harder, heavier and drier than sapwood. In other cases where pliability or elasticity is required, as, for example, in hickory and ash which are used in making baskets or for handles of rakes, hoes and golf clubs, the sapwood is more valuable than the heartwood.

Separating the wood from the bark is a very thin layer, the cambium. From this layer is added new wood on the outside of that already formed and new bark on the inside of the old bark. It is by this process that the trunk grows in diameter. Each year the cambium adds a new layer of wood to the circumference of the tree. These layers appear on the end of the log as concentric rings. They are called annual, yearly or growth rings (h, fig. VIII). In maple, birch, white pine and many other woods there is no sharp distinction between the wood formed in the spring and that formed in summer. In other cases the wood which is formed in the spring, when growth is most rapid, differs in nature from the harder and denser wood formed later in the season. The oaks, elms and hickories present clearly defined layers. The two layers are called early or spring wood and late or summer wood. The presence or absence of well-defined spring and summer wood is an important factor in distinguishing and naming the different woods; in fact, the grain or figure of some kinds of lumber depends entirely upon the difference between spring and summer wood.

Radiating from the center of the trunk toward the bark, like the spokes of a wheel, are slender but more or less distinct lines. These are the medullary rays (i, fig. VIII). Medullary rays serve two functions; they are paths for the conduction of food materials between bark and wood or wood and bark, and they bind the trunk together from pith to bark. Woods differ in the size and number of medullary rays present, the rays being inconspicuous in some and very prominent in others. If an oak log be cut along any of its many radii, i. e., parallel to one of the lines of the medullary rays, the beautiful "flakes" of the quarter-sawed oak are exposed to view. In other trees, like the maples, the medullary rays may be so small as to escape notice. But whether prominent or inconspicuous, the medullary rays help largely to make up the pattern which often readily and surely distinguishes one wood from another.

We have learned from our superficial inspection that a tree is not a simple structure but a complex organism composed of several kinds of tissues, each having its particular function in the life of the tree. In order to continue our study further, it is necessary that we use a hand lens or a compound microscope. If we examine the smoothly cut end of a piece of wood, or, better, a very thin shaving, we find that it is seemingly made up of a network of holes or pores held together by chains of solid tissue, in appearance resembling the chambers of a honeycomb. All trees, all tissues composing trees, are made up of millions of these units, just as a wall is built of bricks and mortar. These units making up the bodies of trees are called cells (fig. IX). A cell may be considered in the nature of a box, but so small is it that it is usually indistinguishable to the naked eye. The walls of the box or cell are composed for the most part of a woody substance called cellulose; we call them cell-walls. In young cells, such as we find in the actively growing parts of trees, the whole cavity of the cell is filled with a slimy substance called protoplasm. The protoplasm is the living substance of the tree; where there is protoplasm, there is life and growth. As the cells grow older and larger, the protoplasm does not continue to fill the whole cavity within the cell-walls, but forms only a thin lining around the walls. Finally it disappears altogether, leaving the dead cell-walls intact, making the substance called wood. The cells composing wood are not all the same shape or size, but vary greatly according to the function which they serve in the life of the tree. Because of the great variety of the cells composing it, wood takes on various characters of structure, graining and coloring, which are distinctive for each kind of wood and which greatly aid in distinguishing the various kinds from one another.

The wood of conifers is very regular and simple, consisting mainly of cells of one sort. It is this uniformity of structure which makes the wood of conifers valuable for so many purposes. These cells are called tracheids (a, fig. IX). They are vertical, elongated, tapering tubes, one-twentieth to one-fifth of an inch in length, with closed ends and a relatively large cavity. The pointed ends of the tracheids overlap one another in a dovetailed fashion, breaking the joints and making the wood much stronger than it would be otherwise. They are further identified by the presence of pits or pores in their walls which serve as waterways between the tubes. These pits (b, fig. IX) appear as if made up of two circles, and they are for this reason called bordered pits. The other cells making up the wood of conifers are the ray cells. These extend horizontally, and in a radial-section appear as tiers of regular, brick-shaped cells. The cells communicate with one another by numerous pits in the walls. In certain genera the medullary rays are bordered by tracheids similar to the ordinary wood tracheids, but designated as ray tracheids. In one of the pines the ray tracheids have teeth-like projections from the walls, which are useful in identifying this species. Scattered here and there on the cross-section of some coniferous woods are to be seen irregular grayish or brownish dots. These are resin ducts and are especially well-represented in the pines. Resin ducts are openings between cells containing resin, which is manufactured by certain trees. If you cut a limb from a pine tree, the cut surface will very quickly become sticky with the resin which oozes from these ducts. On a warm day in the pine woods the resin is quite apparent by its fragrant odor. Some woods have present also certain cells or groups of cells which produce resin, which gives them a distinctive appearance, and therefore they are called resin cells. Their presence or absence aids in the determination of certain woods.

The wood of broad-leaved trees is much more complex in structure than the wood of conifers. Instead of being made up essentially of one kind of cells, tracheids, as is the case in the coniferous woods just mentioned, the wood of broad-leaved trees is composed of several kinds of cells. If we examine the cut end of a red oak branch we notice that the spring wood contains many comparatively large openings which are visible even to the naked eye. These openings are called pores; they are cross-sections of open tubes or vessels or tracheae which run up and down the trunk of the tree and out into the branches and twigs. In the beginning they resembled the tracheids of conifers, i. e., they were made up of separate and distinct cells. Later, the end walls of the cells which met endwise were absorbed, leaving a continuous series of connected cells or a tube (c, fig. IX). These tubes or vessels serve in the living tree as water-carriers. For the sidewise conduction of fluids, the vessels are usually abundantly pitted with bordered pits, but the pits are somewhat smaller than those commonly found in the tracheids of coniferous woods. Furthermore, it is very common for vessels, especially the smaller ones, to be marked with spiral thickenings on their interior walls. The scalariform perforations present in the end partitions of the vessels of a few woods, as seen on the radial-section, are sometimes confused with the true spiral thickenings just mentioned. This point may be definitely determined by an inspection of tangential- as well as radial-sections. Tyloses also occur in the vessels of many of the broad-leaved woods, sometimes being visible to the naked eye. Tyloses are usually rather thin-walled cells which protrude into the cavities of the vessels, where they divide rapidly and grow, sometimes filling the entire cavity and plugging the vessels so as to prevent further conduction of fluids. The value of white oak for cooperage is increased by tyloses, which are especially abundant in the vessels of this wood. They are also well-represented in the locust, in this instance being rather thick-walled.

It is convenient to divide broad-leaved woods into two groups, which are characterized by the size and arrangement of the vessels. In some species of wood the vessels which are formed later in the season are much smaller than those formed earlier. A wood of this kind, with its large pores collected into a row or band in each growth ring, is spoken of as ring-porous. In other woods, the pores are more nearly uniform in size in both spring and summer wood. They are designated as diffuse-porous woods. The wood of the maple is of this character. In many of the diffuse-porous woods the pores are too small to be seen with the naked eye, and in some cases they may even be indistinct when viewed with a lens. They should not, however, because of this, be confused with the non-porous coniferous woods, which they may resemble.

Tracheids in the wood of broad-leaved trees are subordinate elements. They are much smaller and less uniform in size and shape than in conifers and are more abundant in the vicinity of the tubes or vessels. As in conifers, the tracheids bear numerous bordered pits on their walls. In some cases, as in the wood of the ash, tracheids are absent.

Strength, hardness and toughness are given to broad-leaved woods principally by the wood fibers. These are slender, spindle-shaped, sharp-pointed cells with thick walls and narrow cavities (d, fig. IX). Usually they are provided with oblique, slit-like, simple pits. The wood fibers for the most part lie vertically side by side and parallel to one another, but in some woods, like the sycamore, they are more or less interwoven. This makes the wood cross-grained, difficult to work and hard to split.

While the medullary rays of coniferous woods are uniformly small and inconspicuous, they are often broad and prominent in broad-leaved woods. They are largest in the oak, where they may become twenty-five to seventy-five cells wide and several hundred cells high; between these broad rays are numerous smaller ones, mostly uniseriate and from one to twenty cells high. In the sycamore all the rays are broad, while in the beech only a portion of the rays are broad. Ray cells are usually elongated in the radial or horizontal direction and are then termed procumbent. Not infrequently, however, the marginal cells, as in the willow, are elongated vertically; cells of this kind are said to be upright. These differences in the character of the medullary rays are important means of identification.

Another kind of tissue which is more or less prominent in broad-leaved woods is wood parenchyma. Parenchyma consists of vertical groups of short cells, the end ones of each group tapering to a point (e, fig. IX). The cells of parenchyma resemble the cells of the medullary rays; the walls are invariably pitted with rounded, simple pits. The function of the parenchyma is the distribution and storage of the food products manufactured by the leaves. The distribution of parenchyma on the cross-sections of different species is subject to more or less variation, making this feature of considerable importance in classifying woods. Commonly wood parenchyma is grouped around the pores or vessels. In the basswood it occurs in somewhat broken, tangential lines, forming, with the wood fibers, a tier-like arrangement of the wood elements. In the hickory it forms numerous, fine, concentric lines which are as distinct as the rays. In other woods it may be confined to several rows of cells at the outer limit of the growth ring.

As a final feature having some value in the identification of certain of the woods, is to be mentioned the so-called "pith flecks". They are common in many of our native woods, appearing as crescent-shaped, discolored patches on the cross-section and as brownish streaks running up and down the stem in longitudinal-section. Pith flecks are not a special kind of tissue, but are tunnels made by the larvae of a two-winged insect which lives in the cambium during the growing season. These pith flecks have been found to occur in only five families of trees in the United States, namely, the willow, birch, rose, maple and linden families. They are by no means constant in their occurrence; some stems have numerous pith flecks, while other stems of the same species from the same vicinity do not have them. Taken in conjunction with other characters, however, the presence of pith flecks in considerable numbers may aid in the identification of woods.

The subject of wood structure is one of absorbing interest to one who will but take a little trouble to go beneath the surface. Facts will be revealed which have hitherto lain hidden because of our usual cursory method of handling wood. Some practise may be necessary at first, a little patience may be needed at times, but success will be the reward of honest effort. In all identification work a very sharp knife is necessary. Surfaces must be cut cleanly and smoothly, keeping always in mind that a bruised and broken surface reveals but little of the structure of the wood. Large pieces are not essential, even small cuts along the edge will often suffice. Twigs cut easier than seasoned boards and are frequently as instructive as the more mature wood. Wetting the cut surface will usually make the structural features more prominent. Instructive sections may be made with a very sharp knife or razor, or even with a plane, by cutting very thin pieces and mounting them in water or glycerin between two thin pieces of glass. The sections may even be colored to advantage by soaking them for a time in a dye, thus making certain features more evident. Transparent water colors such as are used in coloring photographs and prints are generally available and will be found to serve as well as the usual laboratory stains. The mounts may be examined with a hand lens by holding them between the eye and the light, or they may be viewed with a compound microscope. If the latter is employed, the sections of wood must be cut very thin and the customary thin cover-glass must be used between the wood-section and the microscope lens.

In the key to the woods which follows, it will be noticed that two large divisions have been made, one the porous woods, being the great mass of broad leaved woods, the other the non-porous or coniferous woods. Porous woods have again been divided into two groups, the ring-porous woods and the diffuse-porous woods. The key is constructed on the same principles which have been employed throughout in other keys in this bulletin. For an explanation and illustration of the manner of using a key, the reader is referred to the chapter on "Artificial Keys, How Made and Used" (pages 13 to 15). Attention is called to the fact that both naked-eye and microscopic characters have been introduced into the key to the woods. Naked-eye characters are printed in Roman type, the microscopic in italics. While keys based solely upon naked-eye or macroscopic characters have been published, their use often leads the beginner to wrong conclusions or utter confusion. The insertion of microscopic characters may be considered, then, as a necessary affliction which has been imposed to make accurate determinations easy, rather than to complicate the key. The more common or important woods have been illustrated by cross-, radial- and tangential-sections of the woods. In the preparation of these drawings, photomicrographs of very thin, stained sections of typical wood were taken. Blueprints were subsequently made from the negatives and the outlines of the cells were drawn in with India ink. Finally the prints were bleached, the result being a silhouette of the original wood-section drawn accurately to a scale on a white background.

KEY TO THE WOODS OF VERMONT

In the following key, the Roman type calls attention to characters which may readily be distinguished by the naked eye or by the use of a hand lens, and should not be interpreted as indicating more important characters. The italics represent characters that can be studied only with a compound microscope.

The word in parenthesis indicates the section, cross-, radial-, tangential- or longitudinal-, which shows the point in question to greatest advantage.

a.[1] Pores (cross) visible and conspicuous, at least with magnifier, *i. e.*, *wood composed of three to six kinds of cells, which are not uniform in structure and usually not arranged in definite radial rows;* resin ducts and resin cells (cross) absent; rays (cross) for the most part conspicuous.

b. Growth rings (cross) defined by zones of large pores in the spring wood alternating with the denser summer wood; pores in summer wood small, or few and scattered.

c. Rays (cross), or part of them, broad, easily distinguishable by the naked eye at three feet distance; on close inspection, rays of two kinds, broad and fine.

d. Pores (cross) abruptly diminishing in size from spring wood to summer wood; *tyloses (longitudinal) present, usually abundant in all large pores.*

e. Pores (cross) of spring wood 1-3 rows deep.

f. Pores (cross) of summer wood arranged chiefly in single, radial rows, seldom joined tangentially, the rows extending to the periphery of the growth rings,

Quercus bicolor.

ff. Pores (cross) of summer wood arranged chiefly in double, radial rows, often joined tangentially, the rows rarely extending to the periphery of the growth rings.

g. Radial rows of summer-wood pores (cross) relatively wide; large rays about ¼ inch apart,

Quercus macrocarpa.

gg. Radial rows of summer-wood pores (cross) relatively narrow; large rays about ⅛ inch apart,

Quercus alba.

ee. Pores (cross) of spring wood 3-5 rows deep.

f. Radial rows of small pores (cross) chiefly in several rows, becoming wider toward the periphery of the growth rings; walls of summer-wood pores thin,

Quercus prinus.

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[1] *aa.* See page 211

ff. Radial rows of small pores (cross) chiefly in one row, becoming narrower toward the periphery of the growth rings; walls of summer-wood pores thick, **Quercus muhlenbergii.**

dd. Pores (cross) gradually diminishing in size from spring wood to summer wood; *tyloses (longitudinal) usually scarce or wanting.*

e. *Wood-parenchyma cells (cross) arranged in concentric lines around the pores;* heartwood red-brown, **Quercus velutina.**

ee. *Wood-parenchyma cells (cross) grouped irregularly around the pores;* heartwood light red, **Quercus rubra,** p. 230.

cc. Pores (cross) all fine, indistinguishable by the naked eye at three feet distance; on close inspection, rays of one kind, all fine.

d. Pores (cross) of summer wood small and inconspicuous, or when visible single, grouped, or forming short, broken lines, but never forming extended radial or tangential lines.

e. Rays (cross) clearly distinct to the naked eye at 6-12 inches distance; growth rings for the most part wide to very wide; rays (radial) very high and prominent.

f. Pores (cross) of late summer wood in large groups *of 6-many, joined tangentially by wood parenchyma,* often forming tangential lines plainly visible to the naked eye at a distance of 6-12 inches; *tyloses (tangential) very abundant, densely plugging the vessels;* wood yielding a brown stain when rubbed with a wet, white handkerchief.......... **Robinia pseudo-acacia.**

ff. Pores (cross) of late summer wood in small groups *of 3-6, not joined tangentially by wood parenchyma,* never forming tangential lines which are plainly visible to the naked eye at a distance of 6-12 inches; *tyloses (tangential) only fairly abundant, never plugging the vessels;* wood not yielding a brown stain when rubbed with a wet, white handkerchief....... **Morus rubra.**

ee. Rays (cross) not clearly distinct to the naked eye at 6-12 inches distance, inconspicuous to microscopic; growth rings (cross) for the most part narrow; rays (radial) not high and prominent.

f. Pores (cross) of summer wood *solitary, rarely grouped,* not forming short, tangential lines; wood parenchyma (cross) forming more or less continuous, tangential lines as distinct, or nearly so, as the rays; *tyloses* (*tangential*) *present* .... **Carya,** p. 229.

ff. Pores (cross) of summer wood *usually grouped,* for the most part forming short, tangential lines; wood parenchyma (cross) not forming continuous, tangential lines; *tyloses* (*tangential*) *absent.*

g. Pores (cross) of spring wood 1-2 rows deep, forming a narrow zone not over one-fourth the width of the growth ring.. **Fraxinus, pennsylvanica lanceolata.**

gg. Pores (cross) of spring wood 3-5 rows deep, forming a broad zone one-third to one-half the width of the growth ring.

h. Pores (cross) of summer wood *joined by wood parenchyma,* forming short or more or less extended, tangential lines; wood hard and strong.

i. Lines of pores and wood parenchyma (cross) in summer wood short and broken, mostly near the periphery of the growth ring (*occasionally absent or very indistinct*)..**Fraxinus americana,** p. 225.

ii. Lines of pores and wood parenchyma (cross) in summer wood long, more or less extended, usually well distributed through the growth ring................**Fraxinus pennsylvanica.**

hh. Pores (cross) of summer wood *not joined by wood parenchyma,* rarely forming tangential lines; wood soft and weak............**Fraxinus nigra.**

dd. Pores (cross) of summer wood small, but distinct, grouped or more or less confluent, or joined by wood parenchyma, to form wavy or branching, more or less extended, radial or tangential lines.

e. Pores (cross) of summer wood arranged in radial, branching lines (when very crowded, radial arrangement somewhat obscured); pores (cross) of spring wood plainly visible to the naked eye at a distance of two feet, *strongly oval or elliptical,* occupying nearly half the growth ring......................**Castanea dentata.**

ee. Pores (cross) of summer wood arranged, *or joined by wood parenchyma*, to form wavy or branching, tangential lines; pores (cross) of spring wood not plainly visible to the naked eye at a distance of two feet, *not strongly oval nor elliptical*, not occupying nearly half the growth ring.

f. Lines of summer-wood pores (cross) strongly wavy; *tyloses* (*tangential*) *mostly absent, not densely plugging the vessels;* wood not yielding a brown stain when rubbed with a wet, white handkerchief; growth rings (cross) not very wide.

g. Pores (cross) of spring wood in 3-many rows; pores (cross) of summer wood small, forming thin, rather broken and disconnected, tangential lines, not strongly wavy; heartwood chocolate-brown, **Ulmus fulva.**

gg. Pores (cross) of spring wood usually in a single row, or nearly so; pores (cross) of summer wood large, forming broad, mostly connected, tangential lines, strongly wavy; heartwood light brown or red.

h. Pores (cross) of spring wood large, plainly visible to the naked eye at a distance of 6-9 inches, forming a continuous row; texture coarse; wood hard to split ....**Ulmus americana,** p. 225.

hh. Pores (cross) of spring wood small, not visible to the naked eye at a distance of 6-9 inches, not forming a continuous row, but the larger ones few and rather widely separated; texture medium; wood fairly easy to split............**Ulmus racemosa.**

ff. Lines of summer-wood pores (cross) not strongly wavy; *tyloses* (*tangential*) *present, densely plugging the vessels;* wood yielding a brown stain when rubbed with a wet, white handkerchief; growth rings (cross) very wide ....**Robinia pseudo-acacia.**

bb. Growth rings (cross) not defined by zones of large pores in the spring wood, but pores all the same size, or nearly so, scattered more or less evenly through the growth ring, occasionally more numerous and very often somewhat larger in the spring wood.

c. Rays (cross) usually plainly visible to the naked eye at a distance of 6-9 inches.

d. Rays (cross) uniform, all of them more or less equal in size (see note below[1]).

e. Wood-parenchyma cells (cross) forming continuous or somewhat broken, tangential lines or bands, scarcely visible with a lens; wood light and soft.

f. Wood elements (cross) alternating with parenchyma elements in a tier-like arrangement; *vessels* (*tangential*) *with spirals; rays* (*tangential*) *very narrow, slender-tapering;* color light brown to nearly white, **Tilia americana,** p. 231.

ff. Wood elements (cross) not alternating with parenchyma elements in a tier-like arrangement, *but confined to 2-4 rows of flattened cells at the outer limit of the growth ring; vessels* (*tangential*) *without spirals; rays* (*tangential*) *rather wide, abruptly-tapering;* color bluish to the more common yellow-brown, often striped ....**Liriodendron tulipifera.**

ee. Wood-parenchyma cells (cross) not forming tangential lines or bands; wood moderately heavy and hard.

f. *Ray cells* (*radial*) *about as long as high; vessels* (*longitudinal*) *plugged at intervals with dark red gum;* color rich red-brown or wine.

g. Rays (cross) distinct to the naked eye; pith flecks (cross) usually absent; pores (cross) large and conspicuous under a hand lens.

h. Pores (cross) of the spring wood larger and more numerous than those of the summer wood; *larger rays* (*tangential*) *3-4-seriate;* wood rather soft, **Prunus nigra.**

hh. Pores (cross) of the spring wood not noticeably larger nor more numerous than those of the summer wood; *larger rays* (*tangential*) *6-8-seriate;* wood rather hard.............**Prunus serotina.**

gg. *Rays* (cross) barely visible to the naked eye; pith flecks (cross) usually present, often prominent; pores (cross) rather small and inconspicuous, even under a hand lens.........**Prunus pennsylvanica.**

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[1] The genus *Crataegus* apparently belongs here; but the wood varies so greatly and is of so little importance commercially that no attempt has been made to incorporate it within the key.

ff. Ray cells (radial) about twice as long as high; vessels (longitudinal) not plugged at intervals with dark red gum; color light brown to reddish.

g. Wood cream-white, without reddish tinge; rays (radial) not conspicuously darker than surrounding wood; growth rings (cross) usually very wide, **Acer negundo.**

gg. Wood light red-brown to decidedly reddish; rays (radial) conspicuously darker than surrounding wood; growth rings (cross) usually moderately wide to narrow.

h. Larger rays (*tangential*) *4-6-seriate,* for the most part broader than the pores (cross); pith flecks absent or rare; growth rings more or less distinct; wood very heavy and hard, **Acer saccharum,** p. 223. **Acer saccharum nigrum.**

hh. Larger rays (tangential) *2-3-, or occasionally 4-seriate,* mostly narrower than the pores (cross); pith flecks present, often abundant; growth rings for the most part indistinct; wood rather light and soft.

i. Pores (cross) barely visible to the naked eye with close scrutiny; pith flecks (cross) usually small, neither abundant nor conspicuous, **Acer saccharinum.**

ii. Pores (cross) visible to the naked eye with close scrutiny; pith flecks (cross) usually rather large, sometimes abundant, more or less conspicuous, **Acer rubrum.**

dd. Rays (cross) not uniform, some of them conspicuously broad.

e. Rings (cross) strongly sinuous; wood white, not showing marked graining on tangential- and radial-sections; broad rays (cross) confined to short radii of the concave portions of the rings............... **Carpinus caroliniana.**

ee. Rings (cross) regular, not strongly sinuous; wood brownish to reddish, showing marked graining on tangential- and radial-sections; broad rays (cross) uniformly distributed, not confined to short radii.

f. Rays (cross) mostly all broad; *vessels (tangential) with spirals; rays (tangential) between broad rays rarely or never uniseriate;* wood cross-grained, difficult to split.................. **Platanus occidentalis.**

ff. Rays (cross) only part of them broad; *vessels (tangential) without spirals; rays (tangential) between broad rays mostly uniseriate;* wood mostly straight-grained, easy to split...... **Fagus grandifolia,** p. 227.

cc. Rays (cross) mostly not plainly visible to the naked eye at a distance of 6-9 inches, indistinct to microscopic.

d. Pores (cross), or some of them, plainly visible to the naked eye at a distance of a foot, mostly conspicuous in the spring wood, for this reason often approaching characteristics of ring-porous group; *squarish crystals in cells of wood parenchyma (longitudinal) common.*

e. Heartwood chocolate-brown, heavy and hard, with mild odor, especially when wet; *rays (tangential) mostly 2-3-seriate, thick-tapering*.................. **Juglans nigra.**

ee. Heartwood light chestnut-brown, light and soft, odorless, even when wet; *rays (tangential) mostly uniseriate, slender-tapering*..................... **Juglans cinerea.**

dd. Pores (cross) not visible to the naked eye at a distance of a foot, not conspicuous in the spring wood; *squarish crystals in cells of wood parenchyma (longitudinal) uncommon or wanting.*

e. Vessels (tangential) with spirals.

f. Heartwood pale yellow to whitish; *rays (tangential) all alike, uniseriate throughout, or nearly so,* **Aesculus hippocastanum.**

ff. Heartwood brownish, reddish or dark red-brown; *rays (tangential) not all alike, 1-6-seriate.*

g. Pores (cross) abundant or fairly abundant, rather evenly distributed; growth rings (cross) not sinuous; pith flecks (cross) usually present; wood parenchyma (cross) not forming distinct, tangential markings.

h. Growth rings narrow; cross-section with curious, sinuous-mottled appearance; sapwood whitish, **Pyrus americana.**

hh. Growth rings rather wide; cross-section without sinuous-mottled appearance; sapwood light brown, **Amelanchier canadensis.**

gg. Pores (cross) not abundant, solitary-scattering or in remote, radial lines; growth rings (cross) sinuous; pith flecks (cross) usually absent; wood parenchyma (cross) forming distinct, tangential markings.

Ostrya virginiana.

ee. Vessels (tangential) without spirals.

f. Rays (tangential) all alike, *uniseriate throughout or nearly so;* wood for the most part soft and light.

g. Pores (cross) of summer wood markedly smaller and fewer in number than pores of spring wood, arranged in more or less prominent, wavy, concentric lines; wood (radial) without silky luster; *rays (radial) with both upright and procumbent cells,*

Salix nigra.

gg. Pores (cross) of summer wood not markedly smaller and fewer in number than pores of spring wood, not arranged in more or less prominent, wavy concentric lines; wood (radial) with silky luster; *rays (radial) with only procumbent cells* .... **Populus,** p. 229.

ff. Rays (tangential) not all alike, but some broad, *1-6-seriate;* wood mostly hard and heavy.

g. Growth rings (cross) indistinct, very narrow and crowded together; *tyloses (longitudinal) present; larger rays (tangential) 1-2-, occasionally 3-seriate,*

Nyssa sylvatica.

gg. Growth rings (cross) distinct, not very narrow and not crowded together; *tyloses (longitudinal) absent; larger rays (tangential) 3-6-seriate.*

h. Rays (cross) just visible to the naked eye with close scrutiny; pores (cross) more or less uniformly distributed, neither larger nor more numerous in the spring wood; pith flecks (cross) rare or wanting; wood heavy and hard.

i. Larger rays (tangential) 3-5-seriate; pores (cross) visible to the naked eye with close scrutiny .... **Betula lenta.**

ii. Larger rays (tangential) 1-2-, sometmes 3-seriate; pores (cross) hardly visible to the naked eye with close scrutiny.... **Betula lutea,** p. 227.

hh. Rays (cross) not visible to the naked eye with close scrutiny; pores (cross) not uniformly distributed, but somewhat larger and more numerous in the spring wood; pith flecks (cross) usually rather abundant; wood light and soft.

i. Pores (cross) of spring wood visible to the naked eye with close scrutiny; growth rings (cross) not marked by narrow, whitish, concentric lines; pith flecks (cross) usually small, not conspicuous, **Betula alba papyrifera.**

ii. Pores (cross) of spring wood not visible to the naked eye with close scrutiny; growth rings (cross) marked by narrow, whitish, concentric lines, especially near the periphery; pith flecks (cross) usually large, conspicuous, **Betula populifolia.**

aa. Pores (cross) not visible nor conspicuous, even with magnifier, *i. e., wood composed mostly of one kind of cells (tracheids), which are uniform in structure and arranged in definite radial rows;* resin ducts and resin cells (cross) often present, especially in the summer wood; rays (cross) never conspicuous.

b. Resin ducts or resin cells or both (cross) present, the former usually visible to the naked eye, the latter for the most part prominent and more or less confluent, forming conspicuous tangential lines; fusiform rays (tangential) present (absent in *Juniperus* and *Taxodium*).

c. Resin ducts and resin cells (cross) scattered, single or in groups, but never forming tangential lines; *fusiform rays (tangential) present; rays (radial) with tracheids.*

d. Heartwood distinct in color from sapwood; resin ducts (cross) conspicuous, because of size or color, *the epithelium cells thin-walled; fusiform rays (tangential) broad and prominent, usually with one to several large resin ducts.*

e. Resin ducts (cross) few, widely scattering, *without tyloses;* resin cells (cross) present near the outer limit of the summer wood; *tracheids (radial) with occasional spirals;* heartwood light russet-brown, **Larix laricina,** p. 219.

ee. Resin ducts (cross) numerous, evenly scattered through the rings, *with prominent tyloses;* resin cells (cross) wholly absent; *tracheids (radial) wholly without spirals;* heartwood whitish, orange to reddish.

f. Transition (cross) from spring wood to summer wood gradual, the growth rings distinguished by narrow lines of darker colored summer wood; wood soft and light, slightly resinous; *lateral walls of ray cells (radial) of spring wood with 1-2 large pits to each tracheid.*

g. *Walls of ray tracheids (radial) smooth; pits (radial) on the tangential walls of the summer-wood cells numerous*.................. **Pinus strobus,** p. 215.

gg. *Walls of ray tracheids (radial) conspicuously toothed; pits (radial) on the tangential walls of the summer-wood cells absent,* **Pinus resinosa,** p. 217.

ff. Transition (cross) from spring wood to summer wood more or less abrupt, the growth rings distinguished by broad bands of darker colored summer wood; wood medium hard and heavy, strongly resinous; *lateral walls of ray cells (radial) of spring wood with 2-6 small pits to each tracheid.*

g. Growth rings (cross) wide, the resin ducts small, widely scattering; *fusiform rays (tangential) having the cells of the inflated portion all or mostly thick-walled, not broken out*............**Pinus banksiana.**

gg. Growth rings (cross) narrow, the resin ducts large, chiefly in the summer wood; *fusiform rays (tangential) having the cells of the inflated portion all or mostly thin-walled, all broken out,* **Pinus rigida.**

dd. Heartwood not distinct in color from the sapwood; resin ducts (cross) not conspicuous, of same color as surrounding wood; *fusiform rays (tangential) narrow, not prominent, with only one small resin duct.*

e. Growth rings (cross) wide; resin ducts (cross) rather numerous, *the epithelium cells thin-walled.*

f. Resin ducts (cross) scattered through both spring and summer wood, *with tyloses usually absent; pits (radial) on the tangential walls of the summer wood chiefly confined to the outermost tracheid wall,* **Picea canadensis.**

ff. Resin ducts (cross) confined chiefly to the summer wood, *with tyloses present; pits (radial) on the tangential walls of the summer wood not confined to the outermost wall, but usually numerous,* **Picea mariana.**

ee. Growth rings (cross) narrow; resin ducts (cross) not numerous, *the epithelium cells thick-walled,*
Picea rubra, p. 217.

cc. Resin ducts and resin cells (cross) not scattered, but more or less confluent and forming tangential lines; *fusiform rays (tangential) absent; rays (radial) chiefly or wholly without tracheids.*

d. Wood with odor like cedar oil, especially when wet; heartwood purplish to red-brown, with yellow-white sapwood, its smoothed surface dull; rings (cross) wavy and sinuous,
Juniperus virginiana.

dd. Wood odorless, even when wet; heartwood dull yellow- or gray-brown, differing only in shade from the sapwood, its smoothed surface greasy or waxy; rings (cross) regular, not wavy nor sinuous......**Taxodium distichum,** p. 223.

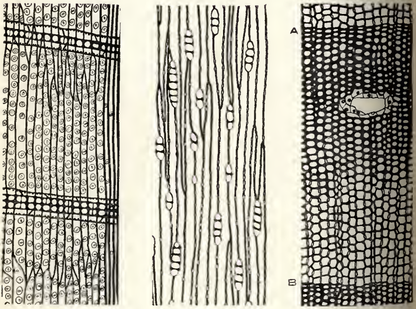
bb. Resin ducts (cross) absent and resin cells (cross), if present not prominent, not forming conspicuous, tangential lines; *fusiform rays (tangential) absent.*

c. Wood with mild odor like cedar oil, especially when wet; heartwood distinct in shade from the sapwood; rings (cross) wavy; wood spongy, difficult to cut smoothly across the grain; *ray tracheids (radial) wholly absent,*
Thuja occidentalis, p. 221.

cc. Wood without odor of cedar oil, even when wet; heartwood not distinct in shade from the sapwood; rings (cross) not wavy; wood not spongy, easy to cut smoothly across the grain; *ray tracheids (radial) present.*

d. Transition (cross) from spring wood to summer wood abrupt; wood light red-brown, with rancid odor, especially when wet, cross-grained, splintery and hard to work; resin cells (cross) prominent, but not numerous; *ray tracheids (radial) prominent*........ ....**Tsuga canadensis,** p. 219.

dd. Transition (cross) from spring wood to summer wood gradual; wood yellow-white to pale brown, odorless, even when wet, straight-grained, not splintery and easy to work; resin cells (cross) absent; *ray tracheids (radial) not prominent, occasional*..................**Abies balsamea,** p. 221.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Pinus resinosa, x 101.

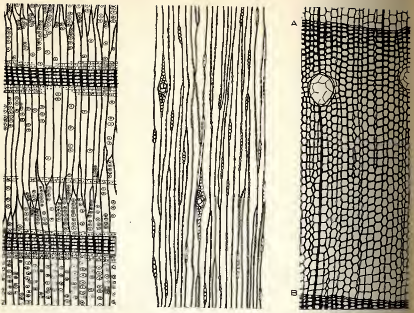
Red Pine. Norway Pine

Pinus resinosa Ait.

CHARACTERISTICS.—Bark thick, red-brown, shallowly fissured into broad, flat ridges; sapwood thin, yellow to white; heartwood pale red; non-porous; growth rings very wide and distinct; transition from spring wood to summer wood very gradual; rays numerous, faintly distinct, with fusiform rays few and these chiefly rather low and broad; resin ducts numerous, evenly scattered through the rings, with prominent tyloses; resin cells absent; tracheids without spirals.

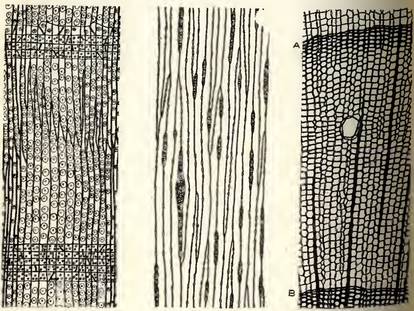
QUALITIES.—Rather light in weight, 31 pounds per cubic foot, seasoned; fairly soft; moderately strong; shrinkage 3 percent; warps moderately; not durable when exposed; straight- and very close-grained; easily worked; splits readily, but nails well.

USES.—Piles, flooring, sheathing, freight cars, poles, masts, etc.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Pinus strobus, x 40.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Picea rubra, x 97.

White Pine

Pinus strobus L.

Characteristics.—Bark thick, dark gray, shallowly fissured into broad, scaly ridges; sapwood thin, whitish; heartwood clear yellow to light brown, turning red on exposure to the atmosphere; non-porous; growth rings wide, distinct; transition from spring wood to summer wood gradual; rays very faint, without resin ducts, the fusiform rays few; resin ducts (vertical) numerous, evenly scattered through the rings, with prominent tyloses; resin cells wholly absent; tracheids entirely without spirals.

Qualities.—Very light in weight, 27 pounds per cubic foot, seasoned; very soft; rather weak; shrinkage 3 percent; warps very little; moderately durable when exposed; very close- and straight-grained; easily worked; splits readily, but nails well.

Uses.—Doors, window-sashes, interior finish and other carpentry, patterns, cabinet-work, matches, boxes, etc.; the most generally useful of all American woods.

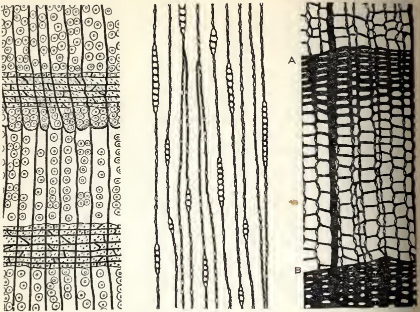
Red Spruce

Picea rubra (DuRoi) Dietr.

Characteristics.—Bark red-brown, with thin, irregular scales; heartwood dull white, with occasional reddish streaks, with sapwood of nearly the same shade; non-porous; growth rings narrow, but distinct; transition from spring wood to summer wood gradual; rays very faint, the fusiform ones narrow; resin ducts few and small, scattered, without tyloses; resin cells absent; tracheids without spirals.

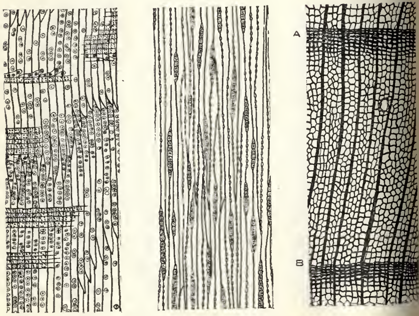
Qualities.—Rather light in weight, 28 pounds per cubic foot, seasoned; soft; fairly strong; shrinkage 3 percent; warps little; fairly durable when exposed; straight-grained; easy to plane and tolerably easy to saw, but hard to chisel neatly; splits easily in nailing.

Uses.—Boats and canoes, oars and paddles, ship timbers, building construction, silos, sounding boards, paper pulp, ladders, etc.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Tsuga canadensis, x 90.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Larix laricina, x 65.

Hemlock

Tsuga canadensis (L.) Carr.

Characteristics.—Bark thick, red-brown or grayish, deeply divided into narrow, rounded, scaly ridges; heartwood light red-brown, ill-smelling, with thin, darker colored sapwood; non-porous; growth rings rather wide, distinct; transition from spring wood to summer wood abrupt; rays numerous, obscure, none of them fusiform; resin ducts absent; resin cells few in number, but prominent; tracheids without spirals.

Qualities.—Rather light in weight, 26 pounds per cubic foot, seasoned; soft; fairly strong; shrinkage 3 percent; warps little; checks badly; not durable when exposed; coarse- and crooked-grained; difficult to work, because brittle and splintery; splits easily, but holds nails well.

Uses.—Dimension materials, timbers, joints, rafters, plank walks, laths, etc.

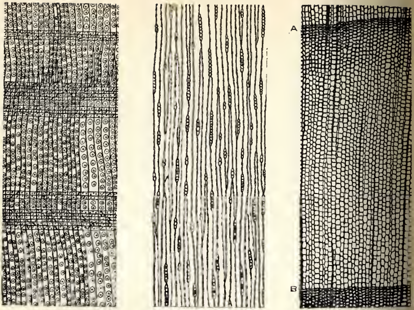
Tamarack

Larix laricina (DuRoi) Koch

Characteristics.—Bark red-brown, scaly, without ridges; sapwood thin, nearly white; heartwood russet-brown; non-porous; growth rings rather broad and uniform, distinct; transition from spring wood to summer wood more or less abrupt; rays inconspicuous, many of them broadly fusiform, prominent and containing resin ducts; resin ducts (vertical) few, widely scattered, without tyloses; resin cells present near outer limit of summer wood; tracheids mostly without spirals.

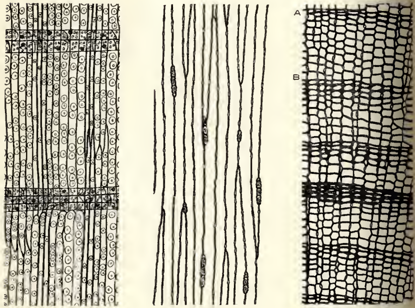
Qualities.—Weight medium, 39 pounds per cubic foot, seasoned; hardness medium; rather strong; shrinkage 3 percent; warps but little; rather coarse-grained; very durable in contact with the soil; easy to work; splits readily.

Uses.—Ship and boat timbers, telegraph poles, fence posts, railroad ties, etc.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Abies balsamea, x 44.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Thuja occidentalis, x 139.

Balsam Fir

Abies balsamea (L.) Mill.

CHARACTERISTICS.—Bark pale gray-brown and marked by swollen resin chambers, or red-brown and roughened by small, scaly plates; sapwood thick, whitish; heartwood yellow-white to pale brown; non-porous; growth rings wide, indistinct; transition from spring wood to summer wood very gradual; rays inconspicuous, never fusiform and mostly without resin ducts; both resin ducts (vertical) and resin cells absent; tracheids without spirals.

QUALITIES.—Very light in weight, 23 pounds per cubic foot, seasoned; very soft; weak; shrinkage moderate; warps little; coarse-grained; perishable in contact with the soil; works easily; splits readily.

USES.—Cut, sold and used with spruce and pine, boxes, crates, packing cases, sheathing, etc.

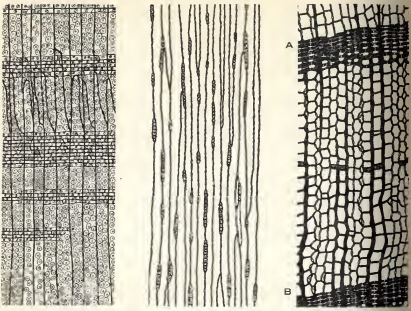
Arbor Vitae. White Cedar

Thuja occidentalis L.

CHARACTERISTICS.—Bark thin, light red-brown, slightly furrowed or deciduous in ragged strips; sapwood thin, whitish; heartwood pale yellow-brown; wood with mild odor like cedar oil; non-porous; growth rings narrow to wide, rather irregular and wavy, fairly distinct by the narrow, but denser summer wood; transition from spring wood to summer wood more or less abrupt; rays very faint, microscopic; resin ducts absent and resin cells few and usually widely scattering; tracheids wholly without spirals.

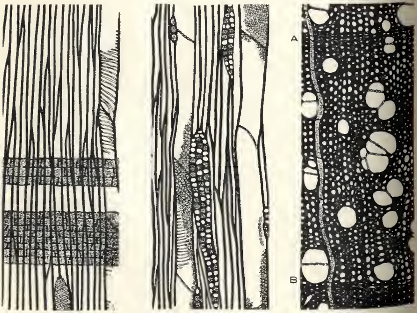
QUALITIES.—Very light in weight, 19 pounds per cubic foot, seasoned; very soft; very weak; shrinks and checks but little; warps little; rather coarse-grained; brittle; very durable in contact with the soil; easily worked; splits easily, but nails well.

USES.—Posts, railroad ties, shingles, etc.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Taxodium distichum, x 47.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Acer saccharum, x 127.

Bald Cypress. Cypress[1]

Taxodium distichum (L.) Richard

CHARACTERISTICS.—Bark light red, shallowly fissured into broad, flat plates and peeling into fibrous strips; sapwood thin, nearly white; heartwood dull yellow- or gray-brown or sometimes blackish; nonporous; growth rings usually very broad and well-marked by the dense and conspicuous summer wood; transition from spring wood to summer wood somewhat gradual; rays very obscure, none of them fusiform; resin ducts absent; resin cells numerous, large, more or less confluent and forming tangential lines on the cross-section; tracheids wholly without spirals.

QUALITIES.—Fairly light in weight, 29 pounds per cubic foot, seasoned; soft; rather weak; shrinkage 3 percent; warps but little, although liable to check; close-grained; very durable in contact with the soil; easy to work; nails well; frequently "peggy" or "pecky" from a fungous disease.

USES.—Shingles, posts, interior finish, boats, cooperage, greenhouse construction, etc.

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[1] Not native to Vermont, but included here because of its widespread use.

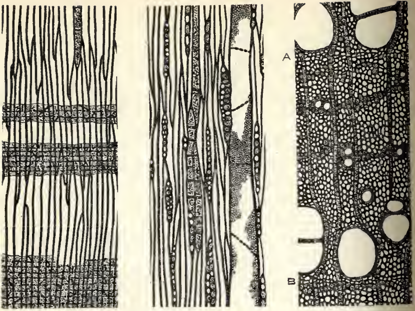
Sugar Maple. Rock Maple

Acer saccharum Marsh.

CHARACTERISTICS.—Bark dark gray and deeply furrowed, often cleaving up at one edge in long, thick plates; sapwood thin, lighter colored than the light brown heartwood; diffuse-porous; growth rings narrow, but distinct; pores somewhat uniform in size, not crowded, inconspicuous; rays fine, but distinct; vessels with spirals.

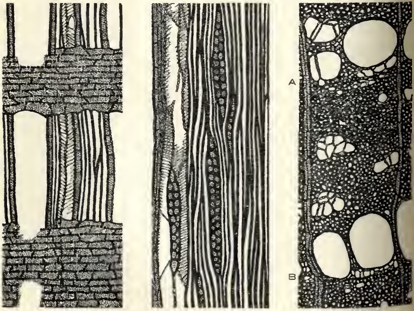
QUALITIES.—Heavy, 43 pounds per cubic foot, seasoned; very hard; very strong; shrinkage 5 percent; warps badly; close-grained, but the fibers sometimes twisted, waved or curly, producing "bird's eye" and "curly" effects; not durable when exposed; wears evenly; splits badly in nailing; hard to work.

USES.—Flooring, fuel, furniture, wagon-stock, carving, tool-handles, etc.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Fraxinus americana, x 92.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Ulmus americana, x 138.

White Ash

Fraxinus americana L.

CHARACTERISTICS.—Bark gray, deeply furrowed into firm, narrow, flattened ridges; sapwood thick, whitish; heartwood brownish; ring-porous; growth rings rather narrow, distinctly marked by 3-5 rows of large pores in the spring wood; pores of the summer wood small and inconspicuous, joined by wood parenchyma to form short, broken, tangential lines, especially near the periphery of the growth ring; rays inconspicuous to microscopic; vessels without spirals.

QUALITIES.—Fairly heavy, 39 pounds per cubic foot, seasoned; rather hard; fairly strong; shrinkage 5 percent; warps little; straight- and close-grained; not durable in contact with the soil; splits readily and nails badly; becomes brittle with age.

USES.—Farm implements, oars, handles, interior finish, cheap cabinet-work, carriage-stock, etc.

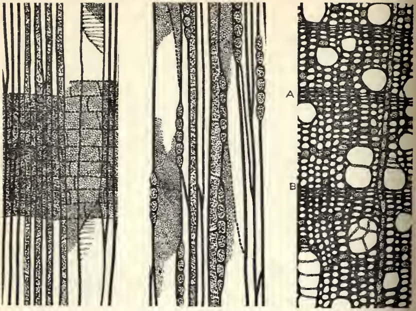
American Elm. White Elm

Ulmus americana L.

CHARACTERISTICS.—Bark ash-gray, deeply fissured into broad, scaly ridges; sapwood thick, yellowish; heartwood light brown; ring-porous; growth rings rather wide, distinctly marked by usually one row of large pores in the spring wood; pores of summer wood somewhat smaller, forming broad, mostly connected, tangential lines, which are strongly wavy; rays numerous, inconspicuous; vessels with spirals.

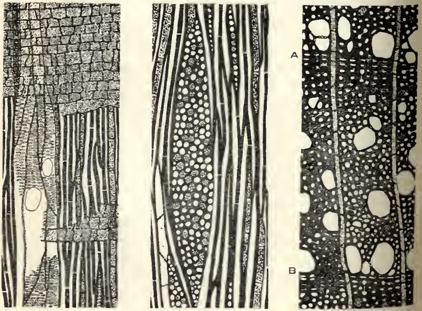
QUALITIES.—Fairly heavy, 34 pounds per cubic foot, seasoned; hardness medium; fairly strong; shrinkage 5 percent; warps and checks considerably; coarse-grained, with the fibers commonly interlaced; not durable in contact with the soil; difficult to split; tough and hard to work.

USES.—Wheel-stock, cooperage, heavy timbers, heavy agricultural implements, etc.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Betula lutea, x 163.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Fagus grandifolia, x 156.

Yellow Birch. Gray Birch

Betula lutea Michx. f.

Characteristics.—Bark silvery yellow-gray and breaking into strips more or less curled at the edges or blackish and deeply and irregularly fissured into large, thin plates; sapwood thin, whitish; heartwood light brown tinged with red; diffuse-porous; growth rings fairly distinct; pores more or less uniform in size, not crowded, inconspicuous; rays numerous, indistinct; vessels without spirals.

Qualities.—Heavy, 40 pounds per cubic foot, seasoned; moderately hard; very strong; shrinkage 6 percent; warps little; close-grained and compact; not durable when exposed; difficult to split and holds nails well; rather hard to work, but polishes well.

Uses.—Furniture, spools, flooring, shoe lasts and pegs, handles, etc.

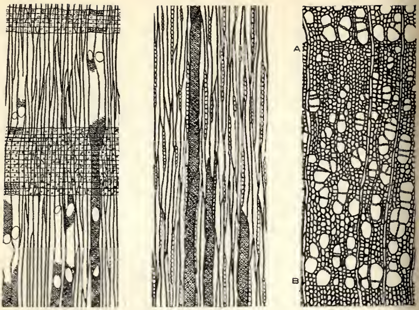
Beech

Fagus grandifolia Ehrh.

Characteristics.—Bark close, smooth, steel-gray, often mottled by darker blotches and bands; sapwood thin, whitish; heartwood light or dark red; diffuse-porous; growth rings obscure; pores largest in spring wood, gradually diminishing in size toward outer limit of summer wood; rays of two kinds, partly very broad and partly very narrow; vessels without spirals.

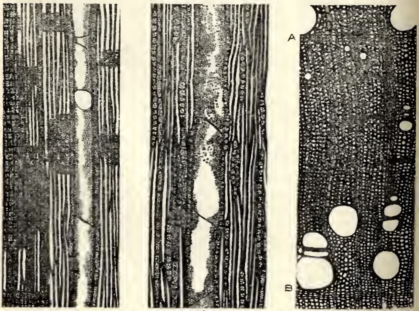
Qualities.—Heavy, 42 pounds per cubic foot, seasoned; rather hard; strong; shrinkage 5 percent; warps and checks during seasoning; straight- and very close-grained; not durable when exposed; moderately difficult to split; tough; hard to work; difficult to nail.

Uses.—Ship timbers, flooring, tool-handles, furniture, fuel, etc.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Populus tremuloides, x 80.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Carya ovata, x 100.

American Aspen. Trembling Poplar. Popple

Populus tremuloides Michx.

CHARACTERISTICS.—Bark thin, yellowish or greenish and smooth, often roughened with darker, horizontal bands or wart-like excrescences; sapwood thin, whitish; heartwood light brown; diffuse-porous; growth rings very wide, not well-defined; pores more or less uniform in size, but rather more crowded in the spring wood; rays very fine and indistinct; vessels without spirals.

QUALITIES.—Very light, 25 pounds per cubic foot, seasoned; soft; weak; shrinks moderately; warps considerably to excessively, but checks little; close-grained; not durable when exposed; works easily.

USES.—Paper pulp, boxes, crates, excelsior, woodenware, etc.

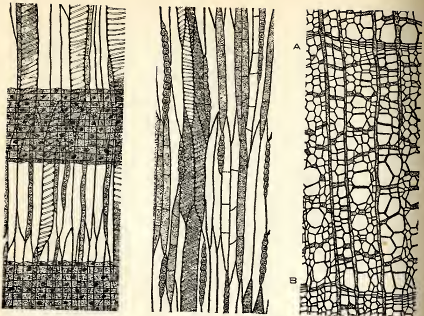
Shellbark Hickory

Carya ovata (Mill.) K. Koch

CHARACTERISTICS.—Bark thick and grayish, separating into thick strips 1-3 feet long, free at one or both ends, giving the log a shaggy appearance; sapwood thin, whitish; heartwood light brown; ring-porous; growth rings narrow, but distinctly marked by the one or more rows of relatively large pores in the spring wood; pores of the summer wood small and inconspicuous; rays numerous, but inconspicuous to microscopic; wood parenchyma forming more or less continuous, tangential lines as distinct, or nearly so, as the rays; vessels without spirals, but containing tyloses.

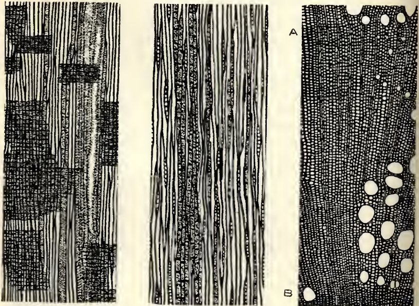
QUALITIES.—Very heavy, 51 pounds per cubic foot, seasoned; very hard; very strong; shrinkage 10 percent; warps badly; straight- and close-grained; not durable when exposed; hard to split and very difficult to nail; very tough and hard to work.

USES.—Agricultural implements, handles, carriage-stock, sled runners, fuel, etc.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Tilia americana, x 112.



RADIAL. TANGENTIAL. CROSS.

Sections of wood of Quercus rubra, x 64.

Basswood

Tilia americana L.

Characteristics.—Bark thick, dark gray or brownish, deeply furrowed into broad, scaly ridges; inner bark fibrous and tough; sapwood thick, light red-brown, hardly distinguishable from the heartwood; diffuse-porous; growth rings rather narrow, but distinct; pores all the same sizes or nearly so, rather evenly distributed; rays numerous, obscure; wood-parenchyma cells forming continuous or somewhat broken, tangential lines or bands, alternating with wood elements in a tier-like arrangement; vessels with spirals.

Qualities.—Light in weight, 28 pounds per cubic foot, seasoned; very soft; very weak; shrinkage 6 percent; very straight- and close-grained; warps comparatively little; not durable in contact with the soil; somewhat tough to split and nails well; very easily worked.

Uses.—Carriage and wagon bodies; woodenware, boxes, toys, numerous small articles, etc.

Red Oak

Quercus rubra L.

Characteristics.—Bark gray-brown, smooth or shallowly fissured into thin, firm, broad ridges; inner bark light red; sapwood thin, darker than the light red-brown heartwood; ring-porous; growth rings rather wide, distinctly marked by several rows of very large pores in the spring wood; pores of summer wood arranged in radial, branching lines, diminishing in size toward outer limits of the summer wood; wood parenchyma grouped irregularly around the pores; rays few, but mostly broad and conspicuous; vessels without spirals.

Qualities.—Rather heavy, 45 pounds per cubic foot, seasoned; fairly hard; rather strong; shrinkage 6-10 percent; warps and checks badly; coarse-grained; moderately durable in contact with the soil; splits readily and nails badly.

Uses.—Furniture, interior finish, cooperage, agricultural implements, fuel, etc.

A LIST OF VERMONT WOODS ARRANGED IN THE ORDER OF THEIR WEIGHT FROM HEAVY TO LIGHT

1. Carya ovata
2. Carya alba
3. Carya glabra
4. Betula lenta
5. Quercus alba
6. Quercus macrocarpa
7. Carpinus caroliniana
8. Ulmus racemosa
9. Quercus velutina
10. Acer saccharum
11. Fagus grandifolia
12. Betula lutea
13. Fraxinus americana
14. Quercus rubra
15. Ulmus americana
16. Fraxinus nigra
17. Fraxinus pennsylvanica
18. Larix laricina
19. Acer rubrum
20. Betula alba papyrifera
21. Prunus serotina
22. Platanus occidentalis
23. Acer saccharinum
24. Juniperus virginiana
25. Pinus resinosa
26. Picea mariana, Picea rubra
27. [1]Taxodium distichum
28. Tilia americana
29. Salix nigra
30. Tsuga canadensis
31. Liriodendron tulipifera
32. Juglans cinerea
33. Picea canadensis
34. Pinus strobus
35. Populus tremuloides
36. Abies balsamea
37. Thuja occidentalis

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[1] Not native to Vermont.

GLOSSARY

WITH PAGE REFERENCES TO EXPLANATORY FIGURES

Abortive. Defective or barren.
Achene. A small, dry, one-seeded fruit in which the ovary wall adheres to the seed.
Acorn. The fruit of the oak.
Acuminate. Gradually tapering to the apex. Page 7.
Acute. Terminating with a sharp angle. Page 7.
Alternate. Said of leaves, branches, buds, etc., scattered singly along the stem; not opposite.
Androgynous. Composed of both staminate and pistillate flowers.
Anterior. The front side of a flower, remote from the axis of inflorescence.
Anther. The part of a stamen which bears the pollen. Page 8.
Apetalous. Without petals.
Apex. The top, as the tip of a bud or the end of a leaf which is opposite the petiole.
Apiculate. Ending in a short-pointed tip.
Appressed. Lying close and flat against.
Arborescent. Attaining the size or character of a tree.
Aromatic. Fragrant; with an agreeable odor.
Axil. The upper one of the two angles formed by the juncture of a leaf with a stem.
Axillary. Situated in an axil.

Bark. The outer covering of a trunk or branch. Page 195.
Bearded. Bearing a long, bristle-like appendage, or furnished with long or stiff hairs.
Berry. A fruit which is fleshy throughout.
Bipinnate. Twice pinnate.
Blade. The expanded portion of a leaf, etc.
Bloom. A powdery or waxy substance easily rubbed off.
Bract. A more or less modified leaf subtending a flower or belonging to an inflorescence.
Branch. A secondary division of a trunk.
Branchlet. A small branch.
Bud. An undeveloped stem or branch, with or without scales.
Bud-scales. Modified leaves covering a bud.
Bundle-scars. Dots on the surface of a leaf-scar, which are scars left by the fibro-vascular bundles which run through the petiole into the blade of the leaf. Page 10.
Bur. A spiny fruit.

Calyx. The outer part of a perianth, usually green in color. Page 8.
Cambium. The ring or zone of tender, growing cells between the bark and the wood.
Campanulate. Bell-shaped.
Capsule. A dry fruit of more than one carpel which splits at maturity to release the seeds.
Carpel. A simple pistil, or one member of a compound pistil.
Catkin. A spike of unisexual flowers, each subtended by a bract, and usually deciduous in one piece.
Cell. One of the minute units or elements, of very various forms, of which plants are formed. Page 195.
Cellulose. The fundamental substance of the cell-wall.
Chambered. Said of pith which is interrupted by hollow spaces.
Ciliate. Fringed with hairs on the margin.
Cinereous. Ash-gray color.
Claw. The narrow, stalk-like base of a petal, sepal, etc.
Cleft. Cut about half-way to the middle.
Cluster. A group of two or more organs (flowers, fruit, etc.) on a plant at a node or end of a stem.
Columnar. Having the form of a column.
Compound. Composed of two or more similar parts united into a whole. *Compound leaf*, one divided into separate leaflets.
Compressed. Flattened laterally.

Concentric. One within another, with a common center.
Cone. A fruit with woody, overlapping scales.
Confluent. Blended or flowing into one; passing by degrees one into the other.
Conical. Cone-shaped, largest at the base and tapering to the apex.
Conifer. A tree of the pine family, so called from its bearing cones.
Coniferous. Cone-bearing; of, or pertaining to, the pine family.
Connective. The portion of a stamen which connects the two cells of the anther.
Cordate. Heart-shaped. Page 7.
Coriaceous. Leather-like in texture.
Corky. Made of, or like cork.
Corolla. The inner part of a perianth, usually bright colored. Page 8.
Corrugated. Wrinkled or in folds.
Corymb. A flower-cluster in which the axis is shortened and the pedicels of the lower flowers lengthened, forming a flat-topped inflorescence, the marginal flowers blooming first. Page 9.
Corymbose. Arranged in corymbs.
Crenate. Dentate, with the teeth much rounded. Page 8.
Crenulate. Finely crenate.
Cross-grained. Having the grain gnarled and hard to cut.
Cross-section. A section of a body at right angles to its length. Page 195, d.
Crown. The upper part of a tree, including the living branches with their foliage.
Cutting. A piece of stem, root or leaf which, if cut off and placed in contact with the soil, will form new roots and buds, reproducing the parent plant.
Cyme. A broad and flattish inflorescence, the central flowers of which bloom first. Page 9.
Cymose. Arranged in cymes.

Deciduous. Not persistent; falling away, as the leaves of a tree in autumn.
Decurrent. Said of a leaf which extends down the stem below the point of fastening.
Decussate. Alternating in pairs at right angles.
Dehiscent. Opening by valves or slits.
Deltoid. Delta-shaped; triangular.
Dentate. Toothed, with the teeth usually pointed and directed outward. Page 8.
Depressed. Somewhat flattened from above.
Dichotomous. Branching regularly in pairs.
Diffuse-porous. Said of wood whose pores are nearly uniform in size and more or less evenly diffused through both spring and summer wood.
Digitate. Said of a compound leaf in which the leaflets are borne at the apex of the petiole; finger-shaped.
Dioecious. Unisexual, with staminate and pistillate flowers on different individuals.
Distribution. The geographical extent and limits of a species.
Divergent. Said of buds, cones, etc., which point away from the twig, or of pine needles, etc., which spread apart.
Dormant. A term applied to parts which are not in active life.
Dorsal. Pertaining to the back or outer surface of an organ.
Downy. Covered with fine hairs.
Drupe. A fleshy or pulpy fruit in which the inner portion is hard or stony.
Duct. See resin duct.

Ellipsoid. An elliptical solid.
Elliptical. Oval or oblong with regularly rounded ends. Page 7.
Emarginate. Notched at the apex. Page 7.
Entire. Without divisions, lobes or teeth.
Epithelium. The somewhat modified parenchyma lining certain intercellular cavities, as the resin ducts.
Epithelium cell. A cell of the epithelium.
Escape. Any plant formerly cultivated that grows wild in fields.
Excrescences. Warty outgrowths or protuberances.
Exfoliate. To cleave off, as of the outer layers of bark.

Falcate. Scythe-shaped.
Fascicle. A compact cluster of leaves or flowers.
Fascicled. Arranged in fascicles.
Fastigiate. Said of branches which are erect and near together.
Feather-veined. Having veins extending from the midrib to the margin, feather-wise.
Fertile. Capable of bearing fruit.
Fertilization. The mingling of the contents of a male (pollen) and female (ovule) cell.
Fibro-vascular bundles. The strands that make up the framework of higher plants.
Filament. The part of a stamen which bears the anther. Page 8.
Filamentose or *Filamentous.* Composed of threads or filaments.
Flaky. With loose scales easily rubbed off (bark).
Fleshy. Succulent; juicy.
Flower. An axis bearing stamens or pistils or both (calyx and corolla usually accompany these). Page 8.
Fluted. With rounded ridges.
Fruit. The part of a plant which bears the seed.
Fungous. Relating to the *Fungi*, i. e., plant organisms of a lower order destitute of chlorophyll.
Fusiform. Thick, but tapering towards each end. *Fusiform ray*, a medullary ray which is fusiform in cross-section.

Germinate. To sprout, as of a seed.
Gibbous. Swollen on one side.
Glabrous. Neither rough, pubescent, nor hairy; smooth.
Gland. Secreting surface or structure; a protuberance having the appearance of such an organ.
Glandular. Bearing glands.
Glaucous. Covered or whitened with a bloom.
Globose. Spherical or nearly so.
Globular. Nearly globose.
Graining. The fibrous arrangement of the particles in wood, determining its hardness, splitting qualities, smoothness, etc.
Gregarious. Growing in groups or colonies.
Growth ring. An annual ring of growth. Page 195, VIII, h.

Habit. The general appearance of a plant, best seen from a distance.
Habitat. The place where a plant naturally grows, as in water, clay soil, marsh, etc.
Hairy. With long hairs.
Halberd-shaped. Like an arrow-head, but with the basal lobes pointing outward nearly at right angles. Page 7.
Heartwood. The dead central portion of the trunk or large branch of a tree. Page 195, VIII, c.
Hirsute. Covered with rather coarse or stiff hairs.
Hoary. Gray-white with a fine, close pubescence.
Homogeneous. Uniform; composed of similar parts or elements.
Hybrid. A cross between two nearly related species, formed by the action of the pollen of one upon the pistil of the other, yielding an intermediate form.
Hybridize. Forming a cross-breed of two species.

Imbricate. Overlapping, like the shingles on a roof.
Indehiscent. Not opening by valves or slits; remaining persistently closed.
Indigenous. Native and original to a region.
Inflorescence. The flowering part of a plant, and especially its arrangement.
Interlaced. Twisted or linked into each other.
Internode. The portion of a stem between two nodes.
Involucral. Pertaining to an involucre.
Involucre. A circle of bracts surrounding a flower or cluster of flowers.

Keeled. With a central ridge like the keel of a boat.
Key-fruit. An indehiscent winged fruit found in maples and ashes.

Laciniate. Cut into narrow, pointed lobes.
Lanceolate. Lance-shaped, broadest above the base and tapering to the apex, but several times longer than wide. Page 7.
Lateral. Situated on the side of a branch.
Leaf. The green expansions borne by the branches of a tree, consisting of a blade with or without a petiole.
Leaflet. One of the small blades of a compound leaf.
Leaf-scar. The scar left on a twig by the falling of a leaf. Page 10, c.
Legume. A pod-like fruit composed of a solitary carpel and usually splitting open by both sutures (*Leguminosae*).
Lenticels. Corky growths on young bark which admit air to the interior of a twig or branch.
Linear. Long and narrow, with parallel edges (as pine needles). Page 7.
Loam. A non-coherent mixture of sand, clay and organic matter.
Loamy. Of the nature of or like loam.
Lobe. Any division of an organ, especially if rounded.
Lobed. Provided with a lobe or lobes. Page 8.
Luster. Brilliancy or sheen; gloss.
Lustrous. Glossy; shining.

Medullary rays. Plates of cellular tissue radiating from the pith to the bark. They are primary when they extend from pith to bark and secondary when they are of less extent than the primary. Page 195, i.
Membranaceous. Thin and somewhat translucent.
Midrib. The central vein of a leaf or leaflet.
Monoecious. Unisexual, with staminate and pistillate flowers on the same individual.
Mucilaginous. Slimy; resembling or secreting mucilage or gum.
Mucronate. Tipped with a small, abrupt point. Page 7.

Naked. Lacking organs or parts which are normally present in related species or genera.
Naturalized. Said of introduced plants which are reproducing by self-sown seeds.
Nectariferous. Producing nectar.
Node. The place upon a stem which normally bears a leaf or whorl of leaves.
Non-porous. Said of wood whose structure is homogeneous, without large pores.
Nut. A hard and indehiscent, 1-celled, 1-seeded fruit.
Nutlet. A diminutive nut.

Oblanceolate. Lanceolate, with the broadest part toward the apex. Page 7.
Oblique. Slanting, or with unequal sides.
Oblong. Longer than broad, with sides approximately parallel. Page 7.
Obovate. Ovate, with the broadest part toward the apex. Page 7.
Obovoid. An ovate solid with the broadest part toward the apex.
Obtuse. Blunt or rounded at the apex. Page 7.
Opaque. Dull; neither shining nor translucent.
Opposite. Said of leaves, branches, buds, etc., on opposite sides of a stem at a node.
Orbicular. Circular. Page 7.
Oval. Broadly elliptical. Page 7.
Ovary. The part of a pistil that contains the ovules. Page 8.
Ovate. Egg-shaped, with the broad end basal. Page 7.
Ovoid. Solid ovate or solid oval.
Ovule. The part of a flower which after fertilization becomes the seed.

Palmate. Radiately lobed or divided; hand-shaped.
Panicle. A loose, irregularly compound inflorescence with pedicellate flowers. Page 9.
Paniculate. Arranged in panicles or resembling a panicle.
Papilionaceous. Butterfly-like, as in flowers of the *Leguminosae.*
Parenchyma. The soft, thin-walled, cellular tissue of plants. Page 195, IX, e.
Parenchyma elements. The cells or units composing the parenchyma.
Pedicel. The stalk of a single flower in a compound inflorescence.

Pedicellate. Borne on a pedicel.
Peduncle. A primary flower-stalk, supporting either a cluster or a solitary flower.
Pendent. Hanging downward.
Pendulous. More or less hanging or declined.
Perfect. Said of a flower with both stamens and pistil. Page 8.
Perianth. The calyx and corolla of a flower considered as a whole.
Periphery. Circumference.
Persistent. Long-continuous, as leaves through the winter, calyx on the fruit, etc.
Petal. One of the divisions of a corolla. Page 8.
Petiolate. Having a petiole.
Petiole. The stem or stalk of a leaf.
Petiolulate. Having a petiolule.
Petiolule. The stem or stalk of a leaflet.
Pilose. Hairy with long, soft hairs.
Pinnate. Compound, with the leaflets arranged along both sides of a common petiole.
Pistil. The seed-bearing organ of a flower, normally consisting of ovary, style and stigma. Page 8.
Pistillate. Provided with a pistil, but usually without stamens.
Pit. A small hollow or depression, as in a cell-wall. Page 195, IX, a.
Pith. The softer central part of a twig or stem. Page 195, VIII, g.
Pith flecks. Dark marks in timber due to the cavities made by the larvae of certain insects working in the cambium.
Pod. A dry and many-seeded, dehiscent fruit.
Pollen. The fecundating grains borne in the anther.
Polygamo-dioecious. Sometimes perfect, sometimes unisexual, both forms borne on different individuals.
Polygamo-monoecious. Sometimes perfect, sometimes unisexual, both forms borne on the same individual.
Polygamous. Sometimes perfect, sometimes unisexual, both forms borne on the same or on different individuals.
Pome. A fleshy fruit, as the apple.
Pore. Any small aperture; a name given to the large vessels or tracheids in hard woods.
Porous. Having large pores visible to the naked eye. See ring-porous and diffuse-porous.
Posterior. The back side of a flower, next to the axis of inflorescence.
Prickle. A small spine growing from the bark.
Procumbent. Lying flat, with the long axis in a horizontal direction.
Protoplasm. The living matter of cells, into which all nourishment is taken and from which all parts are formed.
Puberulent. Minutely pubescent.
Puberulous. Minutely pubescent.
Pubescence. A covering of short, soft hairs.
Pubescent. Covered with short, soft hairs.
Punctate. Dotted with translucent or colored dots or pits.

Raceme. A simple inflorescence of flowers on pedicels of equal length arranged on a common, elongated axis (rachis). Page 9.
Racemose. Resembling a raceme.
Rachis. The central axis of a spike or raceme of flowers or of a compound leaf.
Radial. Radiating, as from a center, i. e., as from the pith.
Radial-section. A longitudinal-section of a body which passes through its center, as the pith of a twig or log. Page 195, VIII, e.
Ray. I. e., medullary ray.
Ray cell. A cell of the medullary ray.
Ray tracheid. A tracheid found in the medullary rays of some trees.
Recurved. Curved downward or backward.
Resin cell. A cell which secretes resin.
Resin duct. A canal or opening between cells containing fluid resin.
Reticulate. Netted.
Rhombic. Equilateral, with the angles oblique.
Ring. Meaning growth ring.

Ring-porous. Said of wood whose large pores are collected into a row or band in each growth ring.

Rough. Harsh to the touch; pubescent.

Rugose. Wrinkled.

Samara. An indehiscent winged fruit.

Sapwood. The living outer portion of a trunk or large branch of a tree between the heartwood and the bark. Page 195, VIII, b.

Scalariform. Having markings suggestive of a ladder.

Scales. Small modified leaves, usually thin and scarious, seen in buds and cones; the flakes into which the outer bark often divides.

Scaly. Provided with scales.

Scar. See leaf-scar.

Scarious. Thin, dry, membranaceous; not green.

Scurfy. Covered with small bran-like scales.

Seed. The ripened ovule.

Sepal. One of the divisions of a calyx. Page 8.

Seriate. Disposed in series or rows.

Serrate. Toothed, the teeth sharp and pointing forward. Page 8.

Sessile. Without a stalk.

Sheath. A thin enveloping part as of a leaf, any body enwrapping a stem.

Shrinkage. A contraction of any material, as wood, into less bulk or dimensions.

Shrub. A bushy, woody growth, usually branched at or near the base, less than 15 feet in height.

Silhouette. A drawing having its outline filled in with uniform color, commonly black.

Simple. Of one piece; not compound.

Sinuate. Strongly wavy. Page 8.

Sinuous. In form like the path of a snake.

Sinus. The cleft or space between two lobes.

Smooth. Smooth to the touch; not pubescent.

Spatulate. Wide and rounded at the apex, but gradually narrowed downward. Page 7.

Sphagnous. Resembling or allied to the genus *Sphagnum*, a moss.

Spike. A simple inflorescence of sessile flowers arranged on a common, elongated axis (rachis). Page 9.

Spine. A sharp woody outgrowth from a stem.

Spirally. As though wound in a spiral around an axis.

Spirals. A term applied to the spiral thickenings of tracheids and vessels. Page 195, IX, c.

Spontaneous. Self-planted or generated; wild or sporadic; growing without human agency.

Spray. The aggregate of smaller branches and branchlets.

Spring wood. The wood produced early in the growing season, characterized by larger ducts and cells and thinner walls than the later growths possess; the inner portion of each annual increment.

Spur. A hollow sac-like or tubular extension of some part of a blossom.

Stamen. The pollen-bearing organ of a flower, normally consisting of filament and anther. Page 8.

Staminate. Provided with stamens, but usually without pistils.

Staminodium. A sterile stamen.

Sterile. Unproductive, as a flower without pistil, or a stamen without anther.

Stigma. The part of a pistil which receives the pollen. Page 8.

Stipules. Leaf-like appendages on either side of a leaf at the base of the petiole.

Stipule-scar. The scar left by the fall of a stipule. Page 10.

Striate. Marked with fine longitudinal stripes or ridges.

Strobile. A cone.

Style. The part of a pistil connecting ovary with stigma. Page 8.

Sub-. A prefix applied to many botanical terms, indicating somewhat or slightly.

Subtend. To lie under or opposite to.

Sucker. A shoot arising from a subterranean part of a plant.

Summer wood. The wood produced late in the growing season, characterized by smaller ducts and cells and thicker walls than the earlier growths possess; the outer portion of each annual increment.
Superposed. Placed above, as one bud above another at a node.
Suture. A junction or line of dehiscence.

Tangential. At right angles to the medullary rays.
Tangentially. In a tangential manner.
Tangential-section. A longitudinal-section of a body at right angles to any one of its radii; any longitudinal-section of a tree trunk which does not pass through the pith. Page 195, VIII, f.
Terete. Circular in cross-section.
Terminal. Situated at the end of a branch.
Ternate. In threes.
Tetrahedral. Having, or made up of, four faces (triangles).
Texture. The disposition, arrangement or character presented by the different elements in the structure of the wood.
Thorn. A stiff, woody, sharp-pointed projection.
Thyrse. A contracted or ovoid and usually compact panicle.
Tissue. The texture or material built up by the union of cells of similar origin and character.
Tolerant. Capable of enduring more or less heavy shade.
Tomentose. Densely pubescent with matted wool.
Toothed. With teeth or short projections.
Torus. The part of the axis of a flower which bears the floral organs.
Trachea. A duct or vessel. Page 195, IX, b.
Tracheid. A long, slender cell, with closed ends and its walls thickened after the cell has attained its full size. Page 195, IX, a.
Transition. Change as from spring wood to summer wood.
Transverse. Said of a wood section made at right angles with the axis of the stem; across the grain.
Tree. Usually defined as a plant with a woody stem, unbranched at or near the base, reaching a height of at least 15 feet.
Trunk. The main stem of a tree.
Turbinate. Top-shaped.
Tylosis. A growth, frequently exhibiting repeated cell-division, intruding within the cavity of a duct or vessel from the wall of a contiguous growing cell.

Umbel. A simple inflorescence of flowers on pedicels which radiate from the same point. Page 9.
Umbellate. Arranged in umbels.
Undulate. With a wavy margin or surface. Page 8.
Uniseriate. In one horizontal row or series.
Unisexual. Of one sex, either staminate or pistillate; not perfect.

Veins. Threads of fibro-vascular tissue in a leaf, petal, or other flat organ.
Vessel. A duct or jointed tube which becomes continuous by the more or less complete absorption of the intervening cross-walls. Page 195, IX, b.
Villose or *Villous.* Covered with long, soft hairs.
Viscid. Glutinous; sticky.

Warp. To become uneven in outline, as by shrinkage; to become twisted or distorted out of shape.
Whorl. An arrangement of leaves or branches in a circle round an axis.
Wing. Any membranous or thin expansion bordering or surrounding an organ.
Wood. The hard part of a stem lying between the pith and the bark.
Wood elements. The cells or units making up the wood.
Wood fibers. Long, slender cells with thick walls and narrow cavities, which impart strength and toughness to the wood and bark. Page 195, IX, d.
Wood parenchyma. A several-celled fiber in which the end cells have pointed extremities while the intermediate cells have square ends. Page 195, IX, e.
Woolly. Covered with long and matted or tangled hairs.

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